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MALAYAN AND EAST INDIAN BLATTIDÆ, I

INTRODUCTION AND SUBFAMILY PANESTHINÆ

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ONE PLATE

INTRODUCTION

The present paper and others expected to follow are based primarily on Blattidæ collected by Prof. C. F. Baker in the Malayan and East Indian Regions and submitted to me for determination and report. Owing to a request that the report be monographic in form, necessitating the inclusion of descriptions of all species occurring in the regions covered and keys, so far as possible, for their separation, it has been thought best to divide the publication into several parts.

In addition to the roaches from Professor Baker there is included in the report the following material:

A small lot of roaches from various places within the regions concerned, loaned for study and determination by the Museum of Comparative Zoölogy, of Cambridge, Massachusetts.

The Blattidæ taken in Java by Bryant and Palmer in 1909 and now in the United States National Museum.

Miscellaneous roaches, both named and undetermined, from regions included in this study and now forming a part of the regular collection of the United States National Museum.

The area covered by this report is that comprising the East Indian Islands proper, a region extending from the Philippines on the north to Sumatra and Java to New Guinea on the south, and also the Malay Peninsula to the Isthmus of Kra, but not

including the neighboring regions of Siam, Formosa, nor the continent of Australia.

In the construction of synoptic keys characters have been employed, so far as possible, which are easily discernible by the average worker; and through multiple entry where necessary, together with explanatory notes to make clearer certain factors tending to create confusion, it is hoped that the reader may be able to place properly most forms treated. The method of employing the more salient characters and the occasional multiple entrance of units into keys is often frowned upon, but if this treatment results in a more certain location of the diverse forms of roaches included it is certainly justifiable. Synoptic keys are too often constructed and units placed therein regardless of whether or not the characters exhibited conform with those used in the keys. Carelessly constructed keys are worse than useless, and keys without decided alternates are an abomination; thus, such alternates as "*a*. Antennæ with from 17 to 22 segments; *aa*. With from 20 to 30," or "*a*. Size large; *aa*. Size smaller," should be avoided when at all possible.

In systematic grouping it sometimes occurs that a unit is classed with an aggregation from which it is actually (through variation) or apparently (through obscure definition of structure) separated by diagnostic characters used in the keys; in such cases, in the present report, the unit is entered under both alternates, thus, it is hoped, preventing the reader from making unnecessarily numerous misdeterminations.

In a later portion of this series of reports keys will be given for the subdivision of the Blattidæ into subfamilies.

PANESTHINÆ¹

These are heavy-bodied roaches, varying from apterous to fully winged, with ventrally unarmed intermediate and posterior femora, the anterior ones armed or unarmed, claws without arolia and the supra-anal plate serrate, undulate or entire, not mesially notched; the pronotal disk is always very noticeably and broadly sulcate or depressed and the anterior margin is generally somewhat hoodlike and elevated and sometimes deeply notched; the pronotal disk and dorsal surface of the abdomen

¹The following references are of importance in the study of this subfamily: BRUNNER, Ann. Mus. Genova 33 (1893) 45-54; SAUSSURE, Rev. Suisse Zool. 3 (1895) 299-330, pl. 9; KIRBY, Syn. Cat. Orth. 1 (1904) 200-205; HANITSCH, Journ. Straits Branch Roy. Asiatic Soc. No. 69 (1915) 145-158.

are usually noticeably punctate or rugose. The anterior margin of the pronotal disk is often finely pilose, but there is scarcely any danger of confusion with the Corydinæ.

The following key will separate the four genera of Panesthinæ occurring in the Malayan and East Indian Regions and also indicates certain roaches of other groups that possess characters causing them to run apparently to this subfamily.

Key to genera of Panesthinæ.

1. Femora armed on cephalic apical margin with two distinct spines (Plate 1, fig. 1). Certain genera of the subfamily Perisphærinæ may fall here, as do certainly the apterous females of the genus *Gymnopeltis*. Members of the subfamily Archiblattinæ, especially immature specimens, may also run out here unless carefully judged. Femora unarmed on cephalic apical margin or with a single short spine (Plate 1, fig. 2)..... 2.
2. Seventh dorsal segment of abdomen, that preceding the broad supra-anal plate, laterally serrate or crenulate (Plate 1, fig. 3)..... 3.
Seventh dorsal segment of abdomen laterally entire or only punctate (Plate 1, fig. 4)..... 4.
3. Both sexes fully winged; fifth dorsal segment of abdomen without lateral projections..... *Salganea* Stål.
Female at least with only lateral padlike tegmina; fifth segment of abdomen with a small lateral projection..... *Mylacrina* Kirby.
4. Sixth segment of abdomen with the posterolateral angle produced into a sharp point..... *Miopanesthia* Saussure.
Sixth segment of abdomen with the posterolateral angle not produced or only triangularly so..... *Panesthia* Serville.

Genus **MIOPANESTHIA** Saussure

Miopanesthia SAUSSURE, Rev. Suisse Zool. 3 (1895) 323; KIRBY, Syn. Cat. Orth. 1 (1904) 205; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 156.

The posterolateral angles of the sixth abdominal segment being produced into a sharp spine distinguishes this genus from its allies. The pronotum is scarcely at all notched anteriorly, and the dorsal depression is less profound than in allied genera. The anterior femora are either unarmed or bispinose ventrally. Adults are probably always fully winged. Supra-anal plate apically entire or denticulate. The two species found in the regions concerned may be separated as follows:

Key to species of Miopanesthia Saussure.

1. Anterior femora armed beneath with two distinct spines; supra-anal plate apically entire; tarsi very slender, the posterior metatarsus as long as the rest of the segments combined..... *M. stenotarsis* Saussure.
Anterior femora unarmed beneath; supra-anal plate apically dentate; tarsi not noticeably slender..... *M. discoidalis* Saussure.

Miopanesthia discoidalis Saussure.

Miopanesthia discoidalis SAUSSURE, Rev. Suisse Zool. 3 (1895) 326;
KIRBY, Syn. Cat. Orth. 1 (1904) 205; HANITSCH, Journ. Str. Br.
Roy. Asiatic Soc. No. 69 (1915) 157.

No specimen of this species has been seen. The type of this species as noted in the original description is probably an immature specimen, being a small apterous roach described from Java and India. Of undoubtedly adult specimens in this genus males only have been reported, and it is questionable just what the adult female is. In fact, the type of the present species may be adult, the male only being winged. Biological investigation or more extensive collection of material will have to settle this point. The original description of *M. discoidalis* is as follows:

♀. Ovata, convexa, nitida, fusco-nigra vel rufescens; antennis pedibusque rufo-testaceis. Thorax et abdominis basis polita, subtiliter sparse punctulati. Pronoti margo anterior reflexus, minute trigonali-incisus; angulis incisurae trigonali-erectis. Depressio anterior retro rotundato-producta; disco proter hoc antice depressionem rotundatam obferente; haec marginibus et linea media subtiliter lineatim granulosis; area antica striolatorugulosa; anguli postice fere rectanguli. Abdomen posterius cribroso punctatum, angulis 6i te 7i segmenti breviter acute productis. Lamina supraanalis margine toto denticulato (denticulis 12-14). Femora antica subtus inermia. Long. 19 mm. (Immatura? aptera). Hab: Java, India.

Miopanesthia stenotarsis Saussure.

Miopanesthia stenotarsis SAUSSURE, Rev. Suisse Zool. 3 (1895) 325, pl. 9, fig. 2; KIRBY, Syn. Cat. Orth. 1 (1904) 205; HANITSCH, Journ. Str. Roy. Asiatic Soc. No. 69 (1915) 157.

This is a small black roach of which only the male has been seen. The original Latin description of the insect is as follows:

♂. Minuta, gracilis, nigra; antennis, ore, ocellis pedibusque rufis. Caput prominulum, politum. Pronotum nitidum, politum, depressum, haud gibbosum, subtiliter sparse punctulatum, tuberculis nullis; margine antico late truncato, plano, haud reflexo. Disci impressio angusta, elongata, retro-acuminata, haud rugosa; pars postica pronoti in medio foveolis 2 ovatis transversis notata. Margines laterales valde arcuati, angulis rotundatis. Elytra sat angusta, abdominis longitudine vel abdomen paulum superantia; castanea, venosa, basi punctata. Alae fuscae, apice parabolice rotundatae. Pedes gracilis. Femora antica bispinosa. Tibiarum spinae graciles ac longae. Tarsi gracillimi; posticorum metatarsus reliquis articulis aequilongus. Abdomen supra ac subtus sat dense, haud grosse punctatum, segmentis 2-5 supra basi prozonam angustam politam et sulcum transversalem obferentibus. Segmenta 6m, 7m angulis spiniformiter productis, spinis 6i quam illae 7i longioribus. Lamina supraanalis minuta, brevis, transversa, polita, vix punctata, margine postico leviter arcuato, utrinque lobo obsoleto. Cerci trigonales acuti. Ultimum segmentum ventrale

truncatum. Lamina infragenitalis polita, parum prominula, margine arcuato.—Java.

Long. corp.	♂ 21 mm.
Elytra	18 "
Pronotum	4.6 mm.
latit. pron.	6.3 "
latit. abd.	8.5 "

Hanitsch² adds the following note:

A specimen (♂) which I took on Mt. Poe, Sarawak, 3500', April 1913, is probably referable to this species. The spines of the 6th and 7th segments are well marked. Its dimensions are as follows:

total length	♂ 30 mm.
body, length	25 "
pronotum, length	7 "
pronotum, breadth	9 "
tegmina, length	25 "

Three adult males have been examined in the present study, all from Tjibodas, Java (*Barbour*) (Museum of Comparative Zoölogy). Also three nymphs from the same locality, Mount Gede, April 20, 1909 (*Bryant and Palmer*), are referred here; two of these are large females, and may really be adults, and one is a small male; the two females have the pronotum smooth and even on the disk, which is posteriorly truncate.

Genus MYLACRINA Kirby

Mylacrina KIRBY, Ann. & Mag. Nat. Hist. VII 11 (1903) 414; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 158.

This genus is based on the female sex only and the description is as follows:

Female.—Front of pronotum bordered by a raised rounded ridge, deeply and triangularly excavated in the middle; the surface rugose, the sides thickly punctured; two broad converging ridges running towards the raised hinder portion, which is furnished with a large tubercle on each side in front, and two in the middle; halfway between the front and hinder tubercles is a shallow depression. Upper surface of body sparingly punctured, except on the sides; but the sixth segment of the abdomen with large and numerous punctures; the seventh coarsely, and the terminal plate more finely, rugose. Fifth and sixth segments of the abdomen with distinct, though small, projecting lateral angles, that on the seventh larger, and slightly oblique, seventh segment twice slightly indented; terminal plate with numerous short blunt teeth. Tegmina lateral, subtriangular, rounded at the extremity, not much longer than the pronotum, and with large and numerous punctures. Wings not visible. Front femora with a strong curved spine at the extremity of the inner carina. Cerci short, rounded, set with fine reddish hair.

²Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 157.

Differs from typical *Dicellonotus*, *Macropanesthia* &c. in the presence of short tegmina, in the lateral projections on segments 5 and 6, &c.

Mylacrina wrayi Kirby.

Mylacrina wrayi KIRBY, Ann. & Mag. Nat. Hist. VII 11 (1903) 141;
HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 158.

The following brief description is quoted from Kirby:

Female.—Black; antennæ, knees, and tarsi dark ferruginous, scape of antennæ, mouth-parts, and pulvilli lighter reddish, upper part of head black, smooth and shining, with a few very fine punctures.

Hab. Perak (*Wray*).

No specimen of this Bornean roach has been seen, nor has it been reported from material other than that upon which the species was based.

Genus PANESTHIA Serville

Panesthia SERVILLE, Hist. Nat. Ins. (1839) 130; KIRBY, Syn. Cat. Orth. 1 (1904) 202; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 147.

Caeparia STÅL, Oefv. Vet. Akad. Forh. 24 No. 10 (1877) 37; KIRBY, Syn. Cat. Orth. 1 (1904) 201.

From the other panesthinæan genera this, the typical genus, is distinguished by the smooth lateral margins of the seventh segment of the abdomen and the nonproduced or but slightly produced posterolateral margins of the sixth segment. There is much variation in most characters exhibited by various species of the genus; thus the fore femora may be either unarmed beneath or armed with from one to four or even five distinct spines, the organs of flight are present and fully developed or abbreviated or entirely absent and the supra-anal plate may be apically undulate, serrate, or crenate or entirely smooth. The size ranges from very large insects to rather small ones. Most species are unicolorously black, but a few are rather brightly variegated.

According to rules of nomenclature, including opinion 65 of the International Commission, *Panesthia mandarina* Sauss., being the only included species, is the type of Stål's genus *Caeparia* which relegates that genus to the synonymy under *Panesthia*. The genus of which the species correctly known as *P. saussurei* Wood-Mason³ is the type is thus without a name. For this the new name *Neocaeparia* is here proposed.

The following key, based primarily on those of former workers, contains so far as it has been possible to enter them all,

³ Journ. Asiatic Soc. Bengal 45 (1876) 190.

species of *Panesthia* coming within the scope of the present study. A few species are interpolated in the key next to species with which they appear to be related but from which they cannot be separated for lack of specimens or adequate descriptions. A couple are listed at the end as unplaced.

Key to species of Panesthia Serville.

1. Supra-anal plate apically dentate, crenate or undulate..... 2.
Supra-anal plate apically entire..... 19.
2. Legs ferruginous. (A small apterous form, very likely the immature stage of some larger species.)..... *P. ferruginipes* Brunner.
Legs black or blackish, or femora and coxæ reddish..... 3.
3. Tegmina unicolorously black or brown, rarely absent..... 4.
Tegmina distinctly bicolored, never absent..... 15.
4. Anterior femora armed beneath with two to four distinct spines, small in nymphs..... 5.
Anterior femora unarmed beneath, rarely armed with a single spine.. 14.
5. Lateral margins of seventh abdominal segment incised at the base of the posterolateral tooth and the tooth obliquely divergent. (The character of divergent posterolateral tooth of the seventh abdominal segment suggests that this form should be referred out of this genus; however, as no specimens have been seen, it is thought best to follow previous writers in placing it here.).... *P. serratissima* Brunner.
Lateral margins of seventh abdominal segment not incised at base of posterolateral tooth, and tooth directed backward..... 6.
6. Tegmina fully developed but often broken partly away..... 7.
Tegmina abbreviated or absent..... 11.
7. Pronotal disk anteriorly conspicuously notched, the angles of the notch hornlike in male and tubercular in female..... 8.
Pronotal disk anteriorly slightly emarginate in male, in female scarcely at all. (Pronotal disk unequal but without elevated tubercles.)
P. angustipennis Illiger.
8. Head black..... 9.
Head light reddish..... *P. ruficeps* Kirby.
9. Size smaller, length seldom over 35 or 36 millimeters.
P. saussurei Stål.
Size larger, usually 40 or more millimeters in length..... 10.
10. Usually slightly larger and the color shiny black..... *P. æthiopis* Stoll.
Usually slightly smaller and the color of tegmina with a reddish tinge, usually distinct when looked at in the right light but sometimes rather obscure..... *P. javanica* Serville.
(*P. kheili* probably falls under this section but may fall under section 5 with *serratissima*.)
11. Tegmina strongly abbreviated but meeting above.
P. brevipennis Brunner.
Tegmina lobiform, lateral..... 12.
12. Tegmina noticeably deep red-brown..... *P. mearnsi* sp. nov.
Tegmina black 13.
13. Antennæ apically yellowish; pronotal disk nearly smooth.
P. lobipennis Brunner.

- Antennæ wholly black; pronotal disk strongly rugose.
P. mearnsi var. *uniformis* var. nov.
14. Tegmina fully developed..... *P. puncticollis* Stål.
 Tegmina lobiform, lateral..... *P. biglumis* Saussure.
 (*P. sinuata* Sauss. comes here also.)
15. Tegmina yellowish with costal margin black, a moderately large black spot on basal half, and apical half almost wholly occupied by a larger black spot, the two spots either united or separate.
P. ornata Saussure.
- Tegmina not as above..... 16.
16. Tegmina wholly reddish brown except extreme base and more than basal half of the broadened portion of costal margin, where the color is piceous; wings entirely reddish brown..... *P. bakeri* sp. nov.
 Tegmina not as above..... 17.
17. Tegmina dark brown with an oblique yellowish stripe which does not cover anal field; wings infuscated..... *P. transversa* Burmeister.
 Tegmina with a broad, brownish or dirty white stripe, which covers anal field; wings subhyaline, the basal half infuscated..... 18.
18. Black; tegminal bands whitish; pronotum anteriorly sinuate.
P. mandarinea Saussure.
 Brown; tegminal bands sordid; pronotum of female entire, or very slightly sinuate..... *P. bramina* Saussure.
19. Anterior femora unarmed beneath..... *P. celebica* Brunner.
 Anterior femora armed beneath with one or two distinct spines..... 20.
20. Both sexes fully winged; size large, length over 35 millimeters.
P. wallacei Wood-Mason.
 Apterous, at least the female; smaller, length less than 35 millimeters.
P. polita Krauss.
- Unplaced, *P. conica* Walker and *P. hilaris* Kirby.

Panesthia æthiopsis Stoll.

Blatta æthiopsis STOLL, Spectres, Blatt. (1913) 3, pl. 1d, fig. 3.
Panesthia æthiopsis KIRBY, Syn. Cat. Orth. 1 (1904) 202.

Nine adult specimens, 5 males and 4 females, present from the Philippine Islands as follows: 4 males and 2 females, Mount Apo, Mindanao, June and July (*E. A. Mearns*); 1 male, Dapitan, Mindanao, (*Baker 10337*); 1 female, Guimaras, J. B. Steere Expedition; 1 female, Polillo, Taylor, collector (*Baker 18670*).

There are also numerous nymphs of various sizes belonging here or to *P. javanica*. The distinctness of these two species is rather doubtful and the recognition of both names is thought best by reason of the fact that otherwise *P. javanica*, an old and much-used name, would fall into the synonymy under an older but very little-used name. Thus, *P. æthiopsis* is here listed as distinct, as it was by Kirby, who writes of it as follows: "This is a much larger and darker insect than the common

P. javanica, Serv., with which it is usually considered to be synonymous."⁴

Panesthia angustipennis Illiger.

Blatta angustipennis ILLIGER, Mag. Insekt. 1 (1801) 185.

Panesthia angustipennis BRUNNER, Syst. Blatt. (1865) 395; KIRBY, Syn. Cat. Orth. 1 (1904) 202; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 149.

Brunner gives the following rather brief description of this species:

Pronoti incisurâ in mare parum profundâ, latere et medio dentatâ; feminae vix impressione indicatâ, dentibus nullis. Elytris nitidissimis, corporis longitudine. ♀ ♂.

long.	♂	♀
corporis	37 mm.	34 mm.
pronoti	8 "	7.5 mm.
Pron. trans.	13 "	12 "
Elytrorum	31 "	30 "

Hab: Borneo; Philippines; Amboina (Brunner). Sumatra (Kirby).

Three adult males seen, 1 from Los Baños, P. I. (*Baker 10340*), and 2 from Mount Salak, Java, 2,500 feet altitude (about 800 meters) (*Bryant and Palmer*).

Panesthia bakeri sp. nov.

? *Panesthia mandarina* HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 149, pl. 6, fig. 33, male (not female).

Description.—Female, the male unknown. Color wholly piceous except the lower border of clypeus and labrum and the pulvilli, which are light, and the tegmina and wings which are reddish brown, the former with the extreme base and the expanded portion of costal margin for more than half its length black; the eyes are slightly lighter than the rest of the head; antennæ wholly black. Anterior femora armed beneath with two stout spines; supra-anal plate with seven scallops (Plate 1, fig. 4); pronotal disk with rather deep depressions as is common in the genus but the surface not strongly rugose or pitted, anterior margin moderately notched; lateral margins of the seventh segment of abdomen with the posterolateral angle forming an elongate triangular point, apically sharply pointed and curved slightly inwards (Plate 1, fig. 4).

Measurements: Length, 34 millimeters; pronotum 6.5; tegmina, 26; width, pronotum, 10.

Type, 1 female labeled: "Luzon Benguet, Baguio" (*Baker 10341*).

⁴ Ann. & Mag. Nat. Hist. VII 11 (1903) 412.

Type in United States National Museum, catalogue No. 25644.

The specimen noted and the figure by Hanitsch in the above cited reference may be the male of this species, or *P. bakeri* may represent a color phase of *P. mandarinaea*. For a discussion of this matter see *P. mandarinaea*, page 654.

Panesthia biglumis Saussure.

Panesthia biglumis SAUSSURE, Rev. Suisse Zool. 3 (1895) 319; KIRBY, Syn. Cat. Orth. 1 (1904) 203; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 150.

♀. Minuta, nigra. Antennæ ferrugineæ. Pronotum impresso-punctatum, tuberculis centralibus minimis vel nullis, invicem remotis; area antica valde granulata; margine antico medio arcuato-inciso; angulis plus minus acutis, trigonalibus, erectis fere retro-reflexis; angulis posticis pronoti rectangularibus. Elytra squamiformia, lateralia, dimidium metanotum superantia, apice rotundato. Alæ angustissimæ, sub elytra reconditæ, tantum apice perspicuæ. Abdomen politum, sparse punctatum; segmentum 7^m et lamina supraanalis crasse irregulariter punctata ac rugata; segmentum 7^m basi utrinque profundissime impresso-foveolato-punctatum. Lamina supraanalis dense rugata, subexcavata, margine postico dense multi-denticulato, denticulus hebetatis, 8-10, ad inferum deflexis, dente laterali plus minus acuta. Ultimum segmentum ventrale biimpressum, dense rugosum, plicis lateralibus longis, deflexis, ipsis dense rugosis. Femora antica subtus inermia. Long. 25,5-27; pronot. 6,5-7,5; latit. 10-10,5; elytr. 4,5-6 mm.

Hab. India; Sikkim (Mus. Calcuttae) (Saussure).—Java?—(Kirby).

This species is not represented in the material studied.

Panesthia bramina Saussure.

Panesthia bramina SAUSSURE, Rev. Suisse Zool. 3 (1895) 322; KIRBY, Syn. Cat. Orth. 1 (1904) 203; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 156.

♀. Nigra vel rufescens. Pronotum transverse ellipticum, breve, dense cribroso-punctatum, tuberculis nullis; margine anteriore truncato, in medio minute subinciso, linea elevata (♀) nulla. Elytra angusta, abdominis longitudine, basi castanea, dehinc vitta lata transversa completa sordide decolore, apicem campi analis tegente; dimidia parte apicali elytri subhyalina, ad vittam luteam fusco-ferruginescente. Alæ fusco-ferrugineæ, tertia parte apicali hyalinæ. Femora anteriora haud spinosa. Abdomen crasse remote impresso-punctatum. Septimi segmenti anguli breviter spinosi. Lamina supraanalis densius punctata, margine postico rotundato-crenulato, utrinque angulo hebetato prominulo. Long. 35; pronot. 7; latit. 12; elytr. 29,5 mm.

Var. Nigra, vitta elytrorum distinctius delineata, canescens?

♂ Pronotum antice leviter sinuatum.

Hab. India; Johore.

No specimens seen.

Panesthia brevipennis Brunner.

Panesthia brevipennis BRUNNER, Ann. Mus. Genova 33 (1893) 51;
KIRBY, Syn. Cat. Orth. 1 (1904) 203.

Brunner's description of this species is as follows:

Pronotum margine antico leviter late rotundato-emarginato, disco planiusculo, tuberculis duobus centralibus minimis instructo, angulis lateralibus obtusis. Elytra abbreviata, segmentum abdominale primum non superantia. Femora antica subtus 2 vel 3-spinulosa. Lamina supraanalis 6-crenulata. ♂.

<i>long. corporis</i>	♂ 34 mm.
" <i>pronoti</i>	" 7,5
<i>lat. pronoti</i>	" 11,2
<i>long. elytrorum</i>	" 12

Patria: Amboina (coll. m.).

This species not seen.

Panesthia celebica Brunner.

Panesthia celebica BRUNNER, Ann. Mus. Genova 33 (1893) 53; KIRBY, Syn. Cat. Orth. 1 (1904) 204.

This species, which is not represented in the material studied, is described by Brunner as follows:

Statura magna. Colore atro. Pronotum margine antico reflexo et obtuse triangulariter emarginato, disco quadri-tuberculato, tuberculis binis anticis altioribus, acuminatis. Elytra perfecte explicata (in exemplo unico praesente mutilata). Pedes atri. Femora antica subtus mutica. Segmentum abdominale dorsale septimum plica transversa curvata instructum. Lamina supraanalis valde transversa, margine postico integro. ♀

<i>long. corporis</i>	♀ 57 mm.
" <i>pronoti</i>	" 13,5
<i>lat. pronoti</i>	" 19,5
<i>long. elytrorum</i>	?

Patria: Insula Celebes septentrionalis (coll. m.).

Panesthia conica Walker.

Panesthia conica WALKER, Cat. Blatt. Brit. Mus. (1868) 23; KIRBY, Syn. Cat. Orth. 1 (1904) 204.

This has never been reported since the original description. Kirby leaves it in this genus with a question, and it is very likely an immature form. Following is the original description:

Female. Larva.—Reddish tawny, finely punctured, increasing in breadth from the head to the fifth abdominal segment. Head roughly punctured towards the mouth, near which there is a blackish band. Prothorax hardly narrower in front; borders not reflexed; sides slightly rounded; disk with two deep oblique furrows which converge hindward; hind border hardly sinuated. Mesothorax and metathorax with the hind angles rounded and

slightly elongated. Abdomen roughly punctured towards the tip, where the border is serrated. Fore femora armed beneath with three spines. Length of the body 13 lines.

The dilated abdomen and other characters sufficiently distinguish it from *P. rufa*.

a. Java. From Mr. Argent's collection.

Panesthia ferruginipes Brunner.

Panesthia ferruginipes BRUNNER. Ann. Mus. Genova 33 (1893) 53;
KIRBY, Syn. Cat. Orth. 1 (1904) 202; HANITSCH, Journ. Str. Br.
Roy. Asiatic Soc. No. 69 (1915) 152.

No specimens have been seen referable to this form. This wingless roach may be the nymph of some winged form. The original description is as follows:

Statura minore. Aptera. Atra, tota impresso-punctata, antennis pedibus et cercis ferrugineis. Pronotum parvum, planum, margine antico rotundato, haud emarginato, tuberculis nullis. Femora antica inermia. Lamina supraanalis multi-crenulata. ♂.

long. corporis	♂ 18,5 mm.
" pronoti	" 5
lat. pronoti	7,5

Patria? (coll. m.).

Panesthia hilaris Kirby.

Panesthia hilaris KIRBY, Ann. & Mag. Nat. Hist. VII 11 (1903) 413;
HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 153.

While, as shown by the following original description quoted from Kirby, this species is described rather fully, it cannot be placed in the key to species, and so is listed at the end. No specimen referable to this form has been found.

Long. corp. 32 millim.; exp. tegm. 62. millim.

Female.—Head smooth, black, face with a few fine punctures, eyes, ocelli, and antennal pits yellow, lower mouth-parts reddish, antennæ black, with a ring formed of two yellow joints at three fourths of their length; thorax above dark chestnut-brown, shading into blackish in front, except at the sides; metathorax light reddish; abdomen mostly black; under surface and legs mostly reddish chestnut. Prothorax with a rounded concavity on the frontal margin, leaving the vertex visible; front of prothorax sparingly punctured, with three shallow carinæ, the middle one very fine, converging behind, where a shallow lyrate depression, sparingly punctured, separates the front of the pronotum from the slightly raised and more thickly punctured hinder part. Front femora with a terminal spine beneath, and a preceding one on the left femur; pulvilli yellow. Abdomen with large depressed punctures; the terminal plate with larger and fewer punctures, the margin somewhat flattened, the extremity rounded. Tegmina yellowish hyaline, the basal third and a spot on the middle of the costa of the right tegmen, corresponding to a stripe on the left tegmen

not reaching the inner margin; wings yellowish hyaline, darker towards the base, and lurid towards the costa.

Hab. Sandakan (*Creagh*).

Panesthia javanica Serville.

Panesthia javanica SERVILLE, Ann. Sci. Nat. 22 (1831) 38; KIRBY, Syn. Cat. Orth. 1 (1904) 202; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 147, pl. 6, fig. 34.

The nymphs of this common form, with the mesonotum and metanotum each marked by two yellow spots, are more conspicuous than the more somber-colored adults. As noted in discussion on a previous page under *Panesthia æthiopis* Stoll, the present species and *P. æthiopis* are very closely related and the nymphs have not been separated. The characters used in the key will generally serve to distinguish this roach from its allies. The tegmina being with a slight reddish brown cast will usually distinguish it from the more uniformly dead black-colored *P. æthiopis*. Kirby says *æthiopis* is larger, but this is seldom very obviously true.

Six adults are referred to *P. javanica*, 1 male and 5 females as follows:

One male, Mount Maquiling, Luzon, P. I. (*Baker 10388*); 1 female, Malinao, Tayabas, P. I. (*Baker 5470*); 1 female, Buitenzorg, Java, April to December, 1896 (*D. G. Fairchild*); 1 female, Megamendg Mountains, Java, altitude 4,800 feet (about 1,460 meters), (*Bryant and Palmer*); 1 female, Buitenzorg, Java (*Bryant and Palmer*); 1 female, Kinabalu, Borneo; also many nymphs of various sizes belonging here or to *P. æthiopis*.

Panesthia lobipennis Brunner.

Panesthia lobipennis BRUNNER, Ann. Mus. Genova. 33 (1893) 51; KIRBY, Syn. Cat. Orth. 1 (1904) 203; BRUNER, Univ. Studies, Lincoln, Nebr. 15 No. 2 (1915) 31.

The single record entitling this species to entrance in the present consideration is the one listed above by Bruner, where it is recorded from Lamao, Bataan Province, Luzon. It seems rather possible that the specimens on which this record is based might have been the form described on page 655 of the present paper as *P. mearnsi uniformis* var. nov. Specimens of *P. lobipennis* from the type locality, Ceylon, are available for study, and nothing referable to it was found in the collections forming the subject of the present paper except the var. *uniformis* here

noted, which might readily be mistaken for *lobipennis* by anyone without specimens of both forms for comparison.

The original description of *P. lobipennis* reads as follows:

Pronotum margine antico leviter late emarginato, angulis emarginationis tuberculatis, disco planiusculo, tuberculis duobus sat remotis, margine postico truncato, angulis acutiusculis. Elytra lobiformia, lateralalia. Femora antica subtus bispinulosa. Lamina supraanalis 3-crenulata. ♂.

long corporis ♂ 30 mm.

" pronoti " 8

lat. pronoti " 11,5

long. elytrorum " 3

Patria: Insula Ceylon (coll. m.).

Panesthia mandarinae Saussure.

Panesthia mandarinae SAUSSURE, Mem. Soc. Genève 17 (1864) 168, pl. 1, fig. 25; MELICHAR Orth. 1 (1870) 106, pl. 3, fig. 23; KIRBY, Syn. Cat. Orth. 1 (1904) 204; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 149, female; ? (id. pl. 6, fig. 33, male). *Caeparia mandarinae* STÅL. Oefv. Vet. Akad. Forh. X 34 (1877) 37.

Saussure originally described this species as follows:

Nigra, nitida, capite prominulo; pronoto brevi et lato, grosse punctato, incisura lata instructo, utrinque tantum subcornigero, sulco profundo, late arcuato; elytris sat angustis, basi nigris, fascia media albida, dein fuscescentibus, apice unicoloribus.

It is not at all certain that this species should have a place in the present paper, as the male described and figured by Hanitsch from Sarawak at the reference cited above, may be *P. bakeri* described on page 649 as a new species. This, however, is not at all sure, the greater expanse of black at the base of the tegmina indicating otherwise. The subuniform coloration of the distal portion of the tegmina, however, suggest *P. bakeri* rather strongly. It may, indeed, result finally that *mandarinae* and *bakeri* represent a range of variation, in which case the latter will fall to varietal rank.

For a discussion of *mandarinae* as the type of *Caeparia* Stål see under the genus *Panesthia* on page 646.

Panesthia mearnsi sp. nov.

Description.—Male and female. Of rather small size, shining black, both above and beneath, with the tegmina deep red-brown. Head not quite concealed beneath pronotum, entirely black except the extreme tips of palpi and usually the lower margin of clypeus, which are lighter or reddish. Pronotal disk strongly depressed in anterior half as usual, a rounded elevation on either

side of ventral depression and a pair of distinctly elevated tubercles on anterior part of posterior raised portion; anterior margin elevated and mesially rather deeply notched, about the same in both sexes. Tegmina extending barely beyond apex of mesonotum, about two and one-half times as long as broad, apically rather narrowly rounded, both margins slightly convex, the whole very gradually tapering (Plate 1, fig. 5); wings absent. Anterior femora unarmed beneath, in one specimen with a single spine on each. Supra-anal plate with apical margin gently sinuate (Plate 1, fig. 6).

Measurements: Total length, male, 27 to 32 millimeters; female, 30; pronotum, male, 7 to 8 millimeters; female, 8; tegmina beyond pronotal disk, male, 4 to 5 millimeters; female, 4 to 5; width, pronotum, male, 10 to 11 millimeters; female, 10.5; tegmina at middle, male, 2.5 to 3 millimeters; female, 2.5.

Described from seven adult specimens, all from Luzon, P. I., July, 1907, taken by the late Dr. E. A. Mearns, in whose honor the species is named. Five of the specimens are males, of which one of the middle-sized is designated type and the others as paratypes A, B, C, and D; of the two females, one is designated allotype and the other paratype E. Type material in United States National Museum, catalogue No. 25625.

This species appears rather distinctive by reason of the reddish brown tegmina, which are conspicuous against the black mesonotum. It does not appear to be very nearly related to any described species, though in some ways it is allied to *P. lobipennis*, especially as noted below under var. *uniformis*.

Panesthia mearnsi var. *uniformis* var. nov.

Description.—Female, the male unknown; similar to the typical form except that the tegmina are uniformly piceous, being concolorous with the rest of the body, and the anal margin is less convex, being almost straight with a slight basal swelling (Plate 1, fig. 7). The reddish band bordering the clypeus is absent, but this apparently signifies little as it is almost absent in one or two specimens of the typical form. Anterior femora unarmed beneath and the supra-anal plate as in the typical form.

Measurements: Total length, 28 millimeters; pronotum, 7; tegmina, beyond pronotum, 3.5; width, pronotum, 10 millimeters; tegmina at middle, 2.

Described from a single specimen, a female from Mount Halcon, Mindoro, P. I., 1906 (*E. A. Mearns*). This is the type

and it is in the United States National Museum, catalogue No. 25626.

This variety, with its piceous tegmina, is very like *P. lobipennis* and may, indeed, be the species recorded by Bruner from Luzon as that species. *Panesthia lobipennis*, however, has the pronotal disk much smoother than has the present form, the anterior femora are armed beneath with one or two spines, and the supra-anal plate has but three sinuations apically while in *P. mearnsi* there are from five to seven. In specimens of *P. lobipennis* in the United States National Museum collection from Ceylon the antennæ are distally yellowish, which is not true of *P. mearnsi*.

Panesthia ornata Saussure.

Panesthia ornata SAUSSURE, Mem. Soc. Genève 33 (1872) 152, pl. 10, fig. 54; KIRBY, Syn. Cat. Orth. 1 (1904) 203; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 154.

The coloration of the tegmina of this handsome little species will serve for its ready recognition; it consists of a yellow background with a large oval black spot occupying most of the distal half of the surface, and another about half as large in the proximal half, sometimes merging with the larger one; the base of the costal margin also is black. The rest of the insect is entirely and uniformly black. The size varies from about 20 to 25 millimeters.

Ten specimens of this roach are present, 5 males and 5 females, all from Baguio, Benguet (*Baker 16407*).

Panesthia polita Krauss.

Panesthia polita KRAUSS, Semon Zool. Forsch. Austr. Mal. Arch. 5 (1903) 754; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 151.

This species, of which no specimen has been seen by me, is described as follows by Krauss:

Statura parva, elongato-ellipsoidea, convexa. Nigra, nitida, punctata. Caput a pronoto parum obtectum, subtilissime punctatum, antennis, clypeo, labro palpisque ferrugineis, maculis ocelliformibus flavis. Pronotum semiorbiculare, postice rotundatum (♂) vel in medio subtruncatum (♀), convexum, haud impressum, subtiliter punctatum, margine laterali parum elevato. Meso- et metanotum impresso-punctata, marginibus lateralibus subelevatis, in ♀ postice late rotundatim emarginata, angulis lateralibus obtusis. Elytra alæque in ♀ nullæ, in ♂? Pedes subtilissime punctati, subglabri. Femora antica subtus bispinulosa. Abdomen impresso-punc-

tatum, tergitis utrinque spinoso-productis, subtus basi rufo-castaneum. Lamina supraanalis ♂ ♀ impresso-punctata, postice sulco intramarginali et utrinque lobulo acuto instructa, margine integro. Cerci trigonales, acuti, rufo-castanei. Lamina subgenitalis ♂ parva, semilunaris, obsolete punctata, ♀ magna semiorbicularis, impresso-punctata.

	♀	
Longitudo corporis	22—25	mm
" pronoti	4,5—6	"
Latitudo "	6,5—8	"

Vorkommen: Tjibodas (Java), Borneo (Collectio mia).

Panesthia puncticollis Stål.

Panesthia puncticollis STÅL, Oefv. Vet. Akad. Forh. 34 No. 10 (1877) 37; KIRBY, Syn. Cat. Orth. 1 (1904) 203.

The original description is as follows:

Præcedenti (*P. Saussurii*) simillima, sed pronoto ubique sat fortiter punctato, elytris antierius punctis raris distinctioribus conspersis, et basi in area anali punctis majoribus et numerosioribus instructis, area costali pone medium pallescente; femora antica inermia. ♀. Long. corp. 23 mm.

No specimen of this species has been found in the material examined.

Panesthia ruficeps Kirby.

Panesthia ruficeps KIRBY, Ann. & Mag. Nat. Hist. VII 11 (1903) 412; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 148.

This species, of which no specimen has been seen in the present study, is described by Kirby as follows:

Size, shape, and general appearance of *P. javanica*, Serv.; front femora likewise trispinose, and the punctuation very similar. Differs as follows:—Dark brownish red, instead of black mixed with red; the centre of the pronotum, the terminal plate of the abdomen above and below, and the labium shading into blackish. Head otherwise light red (black in typical *P. javanica*), smooth and shining, clypeus below transversely striated. Tegmina rather lighter chestnut than in *P. javanica*. Pronotum in front with a distinct central carina in the male, but scarcely more excavated in front in the male than in the female.

Larva with more or less distinct oblique red marks on the meso- and metanotum, often curving round behind into a continuous band, and frequently with additional red marks on the sides.

Hab. Christmas Island.

Panesthia saussurei Stål.

Panesthia saussurei STÅL, Oefv. Vet. Akad. Forh. 34 No. 10 (1877) 37; KIRBY, Syn. Cat. Orth. 1 (1904) 202.

The original description is as follows:

P. javanicæ simillima, sed minor, lateribus pronoti fortius punctatis, elytris antierius punctis subtilibus raris conspersis, abdomine minus dense

punctato, angulis apicalibus laminæ supraanalis obtusioribus; femora antica variant inermes, vel spinis duabus vel una armata. ♂ ♀. Long. corp. 26-32 mill.

A single specimen of this roach occurred in the collections studied, a male from Baguio, Benguet, P. I., Baker No. 10399. This is very like *P. æthiopis* and *P. javanica* except for the smaller size. It may eventually prove to be a diminutive form of one of these larger species.

***Panesthia serratissima* Brunner.**

Panesthia serratissima BRUNNER, Nouv. Syst. Blatt. (1865) 394;
KIRBY, Syn. Cat. Orth. 1 (1904) 203.

The original description is as follows:

Minor. Mas pronoti incisura profunda; femina margine antico pronoti vix emarginato. Segmento ultimo dorsali abdominis, ante angulos posticos, acute sinuato, dente terminali subincurvo, lamina supraanali dentibus confertissimis. Larva tota nigra. ♂ ♀.

Long	maris et fem.
Corporis	25 mm
pronoti	5,5 "
Pron. transv.	8 "
elytrorum	23 "

Not found in the collections studied.

***Panesthia sinuata* Saussure.**

Panesthia sinuata SAUSSURE, Rev. Suisse Zool. 3 (1895) 318; KIRBY, Syn. Cat. Orth. 1 (1904) 203; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 155.

The original description is quoted as follows by Hanitsch:

♂ minuta, nigra. Pronotum utrinque crasse punctatum, tuberculis centralibus trigonalibus, acutis; area depressa antica utrinque granulata, in medio carinulata, margine anteriore late sinuato, angulis rotundatis carina præ-marginali instructo; marginibus lateralibus subrectis, (utrinque sinu notatis); cum marginibus anterioribus angulum obtusum efficientibus; angulis posticis obtusangulis. Elytra condite explicata, basi punctata. Femora anteriora spinis nullis. Abdomen crassime impresso-punctatum; 7i segmenti dentes apicales parum acuti, divergentes scilicet margine laterali segmenti ad dentem distincte obtusangulatim sinuato. Lamina supraanalis margine obtusissime obsolete undato, lobulis 4; angulis lateralibus obtusis. Venter apice crassissime punctatus.—Long. 24,5; pronot. 5,8; latit. 8,5; elytr. 20 mm.

Singapore.

No specimen referable to this form has been seen.

Panesthia transversa Burmeister.

Panesthia transversa BURMEISTER, Handb. Ent. 2 (1838) 513; BRUNNER, Ann. Mus. Genova 33 (1893) 51; KIRBY, Syn. Cat. Orth. 1 (1904) 203; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 154.

No specimen of this species has been seen. Brunner's description, which is also quoted by Hanitsch, follows:

Antennæ apice flavæ. Pronotum ♂ margine antico late et profunde sinuato, sinu medio tuberculato, angulis in cornua incurva productis, ♀ margine antico truncato. Elytra atra, in tertia parte basali fascia obliqua, lata, pallide flava ornata. Pedes atrii. Femora antica subtus inermia. Segmentum abdominale, dorsale septimum margine postico integro, limbato. Lamina supraanalis indistincte crenulata. ♂ ♀.

<i>long. corporis</i>	♂ 34	mm.	♀ 30	mm.
" <i>pronoti</i>	" 6,5		" 5,8	
<i>lat. pronoti</i>	" 12		" 10,5	
<i>long. elytrorum</i>	" 30		" 25	

Patria: Carin Chebà (900–1100 m.).

Hanitsch adds:

Hab: Java (Kirby). Burmah (Brunner; Kirby).

Panesthia wallacei Wood-Mason.

Panesthia wallacei WOOD-MASON, Journ. Asiatic Soc. Bengal 45² (1876) 189; KIRBY, Syn. Cat. Orth. 1 (1904) 204; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 152, pl. 2, fig. 12.

The original description is as follows:

Aterrima, nitidissima. Pronoto ut in *P. morione*, sed nitidiore et distinctius crebriusque punctato. Abdomine sparsim punctulato, punctis apicem versus sensim frequentioribus ac paullo majoribus; segmento ultimo marginibus integro angulisque posticis vix producto; lamina supraanali disco parce fulvo-pilosa, postice rotundata, tota integra, dentibus lateralibus nullis; lamina subgenitali confertim grosse punctata. Cercis tumidis, fulvo-pilosis. Tegminibus alisque pæne ut in *P. morione*; abdominis apicem longe superantibus; venarum omnium parte apicali perspicua utrinque pallida, subhyalina; illorum vena anali recta impressa hyalina. Femoribus anticis basin versus bidentatis. Long. corporis maris, ♂ 36½ mm., pronoti 9½, lat. pronoti lat. 14, long. tegminium 40, alarum 35, long. abdom. 18, abd. lat. (ad medium) 16.

No specimen of this species was found in the material studied in preparing the present paper. Hanitsch records a pair from Gunong Kledang, near Ipoh, Perak, which he took in March,

1898. These had three ventral spines on the anterior femora and showed the following measurements:

	mm.
Total length	42
Body, length	34
Pronotum, length	10
Pronotum, breadth	12.5
Tegmina, length	33

Habitat.—Sinkep Island, near Singapore (Wood-Mason).
Gunong Kledang, Perak (Raffles Museum).

Genus *SALGANEA* Stål

Salganea STÅL, Oefv. Vet. Akad. Forh. 34 No. 10 (1877) 37; KIRBY, Syn. Cat. Orth. 1 (1904) 200; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 145.

The crenate lateral margins of the seventh segment of the abdomen and the presence of fully developed wings will separate this genus from the others of the subfamily Panesthinae. The species of this genus, as well as others of the group, need thorough revision, but a lack of sufficient material makes this impossible at the present time. There are either some species almost inseparable on ordinary external characters or there is decided variation in the concealed genital organs; illustrative of this it may be stated that some males of what are considered *Salganea morio* Burmeister have four chitinous structures rendered clearly visible by removing the subgenital plate and the apically chitinous plate immediately dorsad of it, while in other specimens one or two of these characters are absent; all have a stout recurved hook curving under the edge of the genital cavity to the right and toward the terminus of a partly chitinous transverse ridge; on the left is a similar ridge which is usually without projecting structures; but in one specimen examined there was noted a short, curved, toothlike projection on the lower side, corresponding somewhat in position to that of the right-hand ridge, but much smaller; anterior to and near the right-hand hook mentioned above is a backwardly directed, rather slender, outwardly curved hook, present in three of the four males examined but abortive in the fourth; to the left of the last-mentioned hook and lying in the middle of the cavity near the posterior margin is a broadened but apically sharply pointed chitinous plate, always present but sometimes more deeply embedded in tissue than the other organs here mentioned,

and apparently varying somewhat in shape, one presenting a single apical point while another is seemingly with two points. Whether the variations here noted are indicative of pleural species or not is difficult to judge at the present stage of our knowledge.

The species of this genus found in the regions covered by the present study may be separated as follows:

Key to species of Salganea Stål.

1. Anterior femora armed beneath with two or three stout spines, rarely with but one..... 2.
Anterior femora unarmed beneath..... 3.
2. Size very large, length of female 60 to 70 millimeters or more; pronotum anteriorly with a pair of upwardly and backwardly directed hooked processes *S. papua* Shelford.
Size smaller, rarely if ever as much as 60 millimeters in length; pronotum without processes as noted above..... *S. morio* Burmeister.
3. Size large, 40 millimeters or more in length; pronotal tubercles prominent *S. ternatensis* Brunner.
Size smaller, rarely much over 30 millimeters in length..... 4.
4. Supra-anal plate apically distinctly crenate or denticulate..... 5.
Supra-anal plate apically entire or gently undulate.
S. foveolata Saussure.
5. Smaller, length little over 20 millimeters; habitat Java.
S. amboinica Brunner.
S. rugulata Saussure.
Larger, length 30 millimeters, or slightly more; habitat Philippines.
S. humeralis Caudell.

Salganea amboinica Brunner.

Salganea amboinica BRUNNER, Ann. Mus. Genova 33 (1893) 47;
KIRBY, Syn. Cat. Orth. 1 (1904) 200; BRUNER, Univ. Studies,
Lincoln, Nebr. 15 No. 2 (1915) 30.

Described by its author as follows:

Statura parva. Colore atro. Pronotum margine antico minime inciso, disco inaequali sed tuberculis elevatis nullis. Femora antica subtus inermia. Segmentum abdominale dorsale septimum margine laterali crenulato. Lamina supraanalis crenulata, disco toto impresso-puntato. ♂ ♀.

<i>long. corporis</i>	♂ 21 mm.	♀ 21 mm.
" <i>pronoti</i>	" 4,5	" 4,5
<i>lat. pronoti</i>	" 6,8	" 6,8
<i>long. elytrorum</i>	" 20	" 18

Patria: Amboina (coll. m.).

Four immature specimens of a yellowish color are referred here, all from Tjibodas, Mount Gede, Java, April 20, 1909

(*Bryant and Palmer*). This species seems very near *S. rugulata* Saussure and there is a probability that they may really be the same species. Some variation in the crenation of the posterior margin of the supra-anal plate indicates that this may be the case. In the nymphs examined the number of serrations varies from eight to ten in addition to the larger one on either side next the cerci. (Plate 1, fig. 8, shows a medium form.)

Salganea foveolata Saussure.

Salganea foveolata SAUSSURE, Rev. Suisse Zool. 3 (1895) 304; KIRBY, Syn. Cat. Orth. 1 (1904) 200.

Described as follows:

♀. Statura parva. Tota atra; clypeo et antennarum apice aurantia. Pronotum crassissime remote-punctatum, postice in medio tantum punctis paucis; area antica depressa, crasse granulosa, valde rugosa; margine antico medio leviter angulatim inciso; pone incisuram dentibus 2 retro-deflexis minimis instructo; tuberculis disci nullis. Meso-, metanotum et abdominis segmenta superne maxime polita, nitidissima; in medio impunctata, sed basi serie punctorum crassorum notata; utrinque punctis crassissimis remotis cribrosa; secundi segmenti margines laterales penicillo pilorum ruforum instructo. Segmenta 6-7 utrinque profundissime impressa, punctis impressis ingentibus, foveolatis; in medio polita, punctis nonnullis notata; 7° transverse convexo, margine depresso, punctis crassissimis signato. Dentes angulorum 6ⁱ et 7ⁱ apice obtuse; illi 7ⁱ divergentes, longiores, crassi; margines laterales 7ⁱ sublobati. Lamina supraanalis minus crasse punctata, margine subintegro, angulis lateralibus obtusis; ejus basis utrinque supra cercos incisa. Abdomen subtus crassiuscule punctatum. Elytra basi punctata, campo marginali crassissime punctato. Femora antica subtus inermia. Long. 26; pronot. 6; latit. 9 mm.—*Macassar*. (Mus. Genavense).

A single specimen found in the collections studied, a male from the Philippines, Sibuyan Island (*Baker*). It agrees very well with the above description and the wings are entire, not mutilated as they so often are in this group of roaches. The tegmina of this specimen measure 26 millimeters in length.

Salganea humeralis Caudell. Plate 1, fig. 9.

Salganea humeralis CAUDELL, Can. Ent. 38 (1906) 136; BRUNER, Univ. Studies, Lincoln, Nebr. 15 No. 2 (1915) 41.

Originally described as follows:

Size medium. General colour black, the under surface of the legs and of the body, except the last abdominal segment, or subgenital plate, and

the mouth, except the mandibles, and also the vertex, reddish. The base of the elytra in the anal field is also tinted with reddish. Antennæ dark, hairy. Wings and elytra mostly missing. Anterior femora unarmed. Pronotum very slightly notched anteriorly, the disk with the usual irregular V-shaped depression and unequal elevations, but not distinctly tuberculate, the entire surface punctate. Base of the elytra smooth in the anal field, the costal field densely and coarsely punctate. Abdomen punctured, finer below along the median line, the segments transversely sulcate anteriorly above, more profoundly so towards the sides of the last three; seventh segment laterally irregularly crenulate, the latero-posterior angles divergent. Supra-anal plate rugulosely punctate, the posterior margin dully serrate; subgenital plate marked as the supra-anal plate, posteriorly emarginate.⁵ Cerci short, triangular, hairy reddish in colour.

Length, 30 mm.; pronotum, 7.5 mm.; width, pronotum, 11 mm.; abdomen, 14 mm.

This species has not been reported from specimens other than the type material.

Salganea morio Burmeister.

Panesthia morio BURMEISTER, Handb. Ent. 2 (1838) 513; BRUNNER, Nouv. Syst. Blatt. (1865) 392.

Salganea morio KIRBY, Syn. Cat. Orth. 1 (1904) 200; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 145.

Panesthia regina SAUSSURE, Mem. Soc. Genève 17 (1864) 167, pl. 1, fig. 24.

Salganea regina KIRBY, Syn. Cat. Orth. 1 (1904) 200.

Burmeister's brief description, perhaps based on an immature specimen, is as follows:

Fusco-nigra, pronoti incisura acuta bituberculata; abdominis segmento antepenultimo margine dentato; elytris brevissimis trigonis, alis subnullis. Long. 1½".—New Guinea, Australia.

Brunner's diagnosis of the adult female is as follows:

Aterrima. Pronoti incisurâ anticâ acutâ, subbituberculatâ, disco tuberculis quatuor plus minus distinctis. Elytrorum venis distinctiusculis. Abdominis segmento ultimo dorsali margine laterali dentato. Laminâ supraanali dentibus confertis. ♀.—Ceylon, Java, Amboina.

long.	fem.
corporis	33-52 mm.
pronoti	8-12
pron. transv.	12.5-18
elytrorum	37-?

⁵ This is an error, the subgenital plate being apically entire; the posterior edge is, however, laterally sulcate as is true of all species of these roaches.—A. N. C.

Hanitsch gives the following measurements of a large female in the Raffles Museum from Kota Tinggii, Johore:

	Female. mm.
Total length	55
Body, length	44
Pronotum, length	11
Pronotum, breadth	17
Tegmina, length	46

Fourteen specimens of this fine large roach were among the material studied. Java, Tjibodas, Mount Gede (*Barbour*), 1 male, 1 female; April 20, 1909 (*Bryant and Palmer*), 1 male, 2 females; Buitenzorg, April to December, 1896 (*D. G. Fairchild*), 1 male and 4 females, adults, and 4 female nymphs, 3 in what is probably the last stage and 1 about half grown, the last in very poor condition.

This species has a wide range, occurring in Australia, Java, Borneo, India, etc. All the material seen by me, except one male specimen, has the organs of flight more or less broken away; this fracture in every case commences on the anal margin of the tegmen at the posterior margin of the mesonotum and terminates at the posterior margin of the metanotum, the line of fracture extending in a slightly curved line which is so regular in its course as to cause the tegmina to appear naturally abbreviated; the posterior wings are generally broken off so as to be almost or quite concealed by the tegmina, showing that such alar mutilation is not, at least not altogether, a matter of accident.

Some specimens of these roaches have a number of the large round pits covering the dorsal surface of the terminal portion of the abdomen occupied by the immature stage of a mite, one specimen only in a pit. See notes under the genus on page 660 for a discussion of the concealed genital structures of the male.

Salganea papua Shelford.

Salganea papua SHELFORD, Mem. Soc. Ent. Belg. 15 (1908) 236.

No specimen of this gigantic roach has been seen by me nor has it been reported since its description. The original description is as follows:

♀. Piceous, of large size. Pronotum anteriorly with a wide deep emargination, the angles of this upwardly and backwardly produced to form two hooked processes. Anterior part of pronotum depressed, granulate, with two curved oblique sulci, six small tubercles arranged semicircularly across the pronotum immediately behind the depressed area. Tegmina

and wings considerably exceeding the apex of the abdomen, generally much mutilated or amputated. The first 5 abdominal tergites faintly punctate, the remainder deeply cribrate-punctate. Lateral margins of 7th tergite sinuate, dentate, posterior angles produced, an oblique depressed scar on either side of the disc of this tergite. Margin of supra-anal lamina finely and regularly dentate, a large blunt tooth on either side at the base. Cerci short, conical. Ventral surface more sparsely punctate than dorsal surface. Front femora with two spines on anterior margin beneath.

Total length 75 mm.; length of body 60-67 mill.; length of tegmina 63 mill.; pronotum 14 mill. \times 24 mill.

***Salganea rugulata* Saussure.**

Salganea rugulata SAUSSURE, Rev. Suisse Zool. 3 (1895) 304; KIRBY, Syn. Cat. Orth. 1 (1904) 200; HANITSCH, Journ. Str. Br. Roy. Asiatic Soc. No. 69 (1915) 146.

♀. Gracilis, minuta, nigra; antennis, ore pronoto subtus, femoribus, ventre basi, rufo-fulvis. Pronotum depressiusculum, sparse haud crasse punctatum; area antica subtilius remote punctato; margine antico truncato, transverso, vel medio minute inciso; in hoc casu tuberculos minimos 2 præbente; tuberculis 2 centralibus disci minutis vel nullis. Meso. - metanotum et abdomen nitida, sparse punctata. Segmenta 1-5 frequenter margine (saltem in certo luce) angustissime rufolimbato. Segmenta 5-7 basi subconstricta, utrinque profunde impressa; 7^a postice depressum, subtilius densiusque punctatum, marginibus lateralibus rotundato-crenatis, spina apicali basi divergente. Lamina supraanalis densius haud crasse, vel confertim minute punctata punctis crassioribus intermixtis; margine postico valde denticulato, (denticulis confertis, trigonalibus, apice hebetatis), ac utrinque dente majore acuto. Cerci trigonales, rufidi. Subtus ultimum segmentum, saltem postice, crassiuscule densiuscule punctatum, margine apicali subtruncato, plicis marginis postici rugosis, etsi supra punctatis. Femora antica inermia. Tarsi graciles; metatarso postico tribus articulis sequentibus paulo longiore. — Long. 22; pronot. 4.9; latit. 7.2; elytr. 20; lat. abd. 9.8 mm.

Java (Amboina Br.).

Three adult and five immature specimens of this species present as follows:

Java, Tjibodas, Mount Gede (*Barbour*), 1 large black nymph; April 20, 1909 (*Bryant and Palmer*), 4 large black nymphs; Philippines, Mindanao, Mount Apo, June and July (*E. A. Mearns*), 3 adult females.

One only of the adults has complete wings, the others have the organs of flight partly broken away as previously noted under *S. morio*. In the nymphs the legs and clypeus and other portions of the mouth parts are yellowish, while in the adults the tibiæ and tarsi and most of the femora are black like the rest of the insect. As noted under *S. amboinica*, the present species may not be distinct from that slightly older species.

Salganea ternatensis Brunner.

Salganea ternatensis BRUNNER, Ann. Mus. Genova 33 (1893) 47;
KIRBY, Syn. Cat. Orth. 1 (1904) 200.

? *Salganea dux* KIRBY, Ann. & Mag. Nat. Hist. VII 11 (1903) 408;
Syn. Cat. Orth. 1 (1904) 200.

Brunner's description is as follows:

Pronotum utriusque sexus margine antico anguste emarginato, ad emarginationem utrinque tuberculato, disco tuberculis binis anticis altis, acuminatis, tuberculis posterioribus subobliteratis. Femora antica subterinermia. Lamina supraanalis dense ferrugineo-hirsuta, margine postico subintegro. ♂ ♀.

<i>long. corporis</i>	♂ 43 mm.	♀ 42 mm.
" <i>pronoti</i>	" 11	" 10
<i>lat. pronoti</i>	" 16,4	" 15,5
<i>long. elytrorum</i>	" ?	" 45

Patria: Insula Ternate (coll. m.).

Salganea dux of Kirby is listed above as a synonym of *S. ternatensis* with a query, as no essential characters appear to separate them. Kirby's description is here quoted:

Long. corp. 43 millim.; lat. pron. 17 millim.; lat. abd. 22 millim.; exp. al. 117 millim.

Female.—Dark reddish chestnut above, shading into blackish at the extremities and on the lower part of the clypeus; under surface and legs of a lighter red; head dark reddish brown, shining; ocelli, labrum, and base of labium testaceous; labium otherwise light red; terminal plate of abdomen black above and below; pronotum with a broad upcurved ridge, from whence rises a semidetached frontal hood, deeply indented in the middle; pronotum thickly punctured, the central tubercles of the raised portion quite small, the outer ones rising into very large pyramidal but somewhat obtuse teeth; meso- and metanotum with deep carinae, enclosing a triangle very broad at the base and obtusely pointed behind; the metanotum, and to a less extent the mesonotum, is obtusely and broadly angulated behind; the meso- and metanotum and the basal segments of the abdomen smooth and very sparingly punctured, the last three abdominal segments and the terminal plate increasingly thickly punctured both above and below; terminal plate, hinder half of the last segment of the abdomen, the extremity of the one preceding, and the cerci clothed with short testaceous hair; seventh segment with the sides distinctly dentated, and with a large terminal tooth; terminal plate rounded and entire, with only a strong tooth on each side just beyond the cerci. Front femora with only a terminal spine on the outer carina beneath. Tegmina and wings smoky brown, the extremities and the anal half of the wings smoky hyaline.

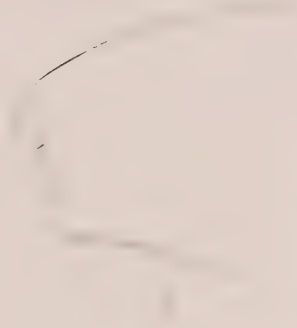
Hab. Obi (Van Duivenborg).

No specimens of *S. ternatensis* occurred in the collections studied nor have additional specimens been reported since the original descriptions of that species and its synonym *S. dux*.

ILLUSTRATION

PLATE 1. MALAYAN AND EAST INDIAN BLATTIDÆ

- FIG. 1. *Gymnopeltis cryptospila* Walker. Ventro-apical margin of posterior femora.
2. *Panesthia æthiopis* Stoll. Ventro-apical margin of posterior femora.
3. *Salganea morio* Burmeister. Lateral margin of seventh abdominal segment.
4. *Panesthia bakeri* sp. nov. Lateral margin of seventh abdominal segment and entire supra-anal plate.
5. *Panesthia mearnsi* sp. nov. Left tegmen.
6. *Panesthia mearnsi* sp. nov. Supra-anal plate.
7. *Panesthia mearnsi* var. *uniformis* var. nov. Left tegmen.
8. *Salganea amboinica* Brunner. Supra-anal plate.
9. *Salganea humeralis* Caudell. Supra-anal plate.



LES ONTHOPHAGUS (COLEOPTERA, SCARABÆIDÆ) DES ILES PHILIPPINES

Par A. BOUCOMONT

Cosne (Nievri), France

Genus ONTHOPHAGUS Latreille

Tableau des especes.

- 1 (2). Premier article des antennes denté en scie; milieu de la tête avec une seule carène, obsolète chez les mâles. Base du vertex armé d'une lame surmontée d'une corne courte ♂, ou d'un tubercule transverse ♀. Thorax à ponctuation simple, nettement anguleux à la base. Tibias antérieurs ♂ prolongés en une griffe dépassant l'insertion des tarses. Noir, peu luisant (type). Brun bronzé, dessous testacé ainsi que les côtés du thorax, le sommet des élytres et le pygidium; parfois thorax testacé avec une grande tache discale brune, élytres testacés avec les interstries impairs rembrunis (var. *mindanaensis* Bouc.). Longueur, 12 à 14 millimètres..... *O. wallacei* Har.
- 2 (1). Premier article des antennes non denté en scie; tibias antérieurs non prolongés en griffe au sommet.
- 3 (4). Thorax, élytres et pygidium couverts de granules ovales serrés. Tête ovale, ponctuée, épistome entier, front sans carène ♂; tête granulée, épistome incisé, front avec une carène fine ♀. Thorax généralement marqué de deux fovéoles lisses près des angles postérieurs. Dessus à pubescence blanchâtre; coloration variable, brun bronzé ou bleu d'acier, les élytres parfois testacés, en totalité ou en partie. Longueur, 4 à 9 millimètres.
O. rudis Sharp.
- 4 (3). Thorax et élytres non granulés.
- 5 (8). Eperon des tibias postérieurs bifide. Tête grande, vertex prolongé en arrière en une lame coupante conchée sur le thorax.
- 6 (7). Carène frontale prolongée jusqu'aux bords latéraux de la tête, un petit tubercule ponctiforme derrière cette carène, vertex armé de deux cornes à section triangulaire, portant sur leur face antérieure une carène sinueuse prolongée, jusqu'aux sutures génales. Sommet du thorax avec deux courtes carènes longitudinales. Elytres à interstries dorsaux lisses, les latéraux un peu ridés à ponctuation superficielle. Noir mat. Longueur, 12 millimètres..... *O. baeri* Bouc.
- 7 (6). Carène frontale réunie aux sutures génales qui sont en saillie, formant avec elles une ligne brisée, front sans tubercule, vertex armé de deux cornes plates, spatuliformes, très courtes, terminées par un petit tubercule sphéroïdal. Thorax à ponctuation râpeuse, muni en avant d'un lobe plat, plus ou moins nettement

- bifide. Intervalles des élytres couverts de fins granules sétigères. Brun de poix plus ou moins bronzé, parfois verdâtre, thorax souvent bordé de testacé latéralement, élytres souvent roussâtres, plus rarement d'un noir bleuâtre. Longueur, 5.5 à 9 millimètres..... *O. praedatus* Har.
- 8 (5). Eperon des tibias postérieurs simple.
- 9 (26). Espèces entièrement glabres ou ayant seulement sur les intervalles latéraux des élytres une pubescence extrêmement courte et peu visible.¹
- 10 (23). Base du thorax non rebordée.
- 11 (16). Base du thorax anguleuse, subdentée au milieu. Tête avec une carène frontale souvent obsolète, vertex muni d'une carène en arrière du bord postérieur des yeux. Thorax mutique à ponctuation simple, très fine, de coloration métallique rouge doré ou vert.
- 12 (13). Metasternum caréné et tectiforme en avant, couvert de granules. Epistome unidenté au sommet, carène frontale presque nulle, vertex légèrement relevé en buttoir à la base, ne formant pas une carène nette. Thorax sans impressions obliques à la base. Tête et thorax d'un rouge doré luisant, élytres noirs, mats. Longueur 7 à 11 millimètres..... *O. semiaureus* Lansb.
- 13 (12). Metasternum non caréné en avant; taille plus petite. Epistome non denté, carène frontale bien marquée, vertex nettement caréné; base du thorax marquée de deux impressions obliques près des angles postérieurs.
- 14 (15). Prothorax rouge doré, élytres noirs, mats. Longueur 5 à 6.5 millimètres *O. semicupreus* Har.
- 15 (14). Prothorax vert plus ou moins cuivreux, élytres d'un vert foncé un peu terne, luisants; ponctuation des stries plus nettement transverse. Longueur, 4 à 6 millimètres.... *O. pilularius* Lansb.
- 16 (11). Base du thorax non dentée, dessus concolore.
- 17 (18). Dessus mat. Large, noir ou brun. Epistome trapezoïdal à bords fortement relevés, carène frontale continuée jusqu'aux bords latéraux de la tête, vertex armé d'une lame portant deux cornes larges et plates à la base. Thorax à base arrondie marqué d'une ponctuation très fine et serrée, brièvement rétus en avant, armé d'un très petit tubercule. Intervalles des élytres à ponctuation obsolète ou nulle. Pygidium superficiellement caréné dans sa longueur. Longueur, 8 à 11 millimètres.
O. dapitanensis Bouc.
- 18 (17). Dessus luisant.
- 19 (20). Stries des élytres très larges. Noir, tête et thorax bronzé ou verdâtre. Tête plane, inerme, finement ponctuée; thorax à ponctuation subombiliquée, sans sillon médian, bords latéraux rectilignes ou faiblement sinués en avant, fortement sinués en arrière. Stries des élytres marquées de points transverses, plus profonds le long du bord latéral, intervalles subconvexes, finement alutacés, à ponctuation finement râpeuse, peu serrée.

¹ Voir plus loin *O. rasilis*, dont la pubescence est très courte.

Pygidium à très grosse ponctuation serrée. Prosternum excavé. ♂ Epistome anguleux à sommet réfléchi; thorax armé de deux tubercules près des angles postérieurs, déterminant deux plans inclinés vers les angles antérieurs. ♀ Epistome arrondi, thorax simple. Longueur, 4,5 à 5 millimètres.... *O. bangueyensis* Bouc.

20 (19). Stries des élytres étroites.

21 (22). Taille petite; noir ou brun. Vertex inerme ♂, ou avec une carène obsolète ♀; carène frontale courbe reliée aux sutures génales. Thorax très convexe, rétréci à la base, bords latéraux presque rectilignes en avant, à peine sinués en arrière, surface assez densément et fortement ponctuée. Stries des élytres enfoncées, fortement ponctuées, toutes libres au sommet, intervalles convexes à ponctuation très fine, espacée. Ponctuation du pygidium assez grosse avec des poils courts, dressés. Longueur, 4 à 4,5 millimètres..... *O. inermivertex* Bouc.

22 (21). Taille moyenne; vertex armé d'une corne, d'une lame ou d'une carène très nette. Noir, luisant, avec un très faible reflet bronzé sur le thorax. Tête finement ponctuée; thorax à ponctuation fine peu serrée; intervalles des élytres plats, à ponctuation fine sur les latéraux, les dorsaux lisses. ♂ Epistome anguleux à sommet arrondi, portant en son milieu un appendice en forme de T; vertex armé d'une corne fourchue, plate, en forme de Y; front sans carène; thorax gibbeux et rétus en avant. ♂ minor (var. *sus* Bouc.). Epistome tronqué et relevé en groin, vertex armé d'une lame bifurquée en deux cornes courtes, plates. ♀ Epistome trapézoïdal, front gibbeux avec une carène courte, atténuée à ses extrémités; vertex muni d'une forte carène située au niveau du bord postérieur des yeux, occupant la moitié de leur intervalle; thorax non gibbeux mais avec une trace de lobe au sommet. Longueur, 8 à 9 millimètres *O. galeatus* Bouc.

23 (10). Base du thorax rebordée. Epèces noires.

24 (25). Peu luisant; thorax à ponctuation homogène, écartée, angles arrondis au côté externe; septième strie des élytres sinueuse; ponctuation du pygidium à peine plus grosse que celle du thorax. ♂ Tête grande, trapézoïdale, épistome tronqué, front muni d'une carène reliée aux sutures génales, vertex armé d'une forte lame couchée sur le thorax, surmontée de deux cornes hélicoïdales courtes, convergeant au sommet; thorax un peu rétus en avant, sans arête ni carène. ♀ Front avec deux carènes en courbes concentriques, l'antérieure reliée aux sutures génales; vertex muni d'une carène élevée à sommet sinué. Longueur, 6 à 9 millimètres..... *O. armatus* Blanch.

25 (24). Très luisant; thorax à ponctuation fine et écartée sur le disque, plus grosse et plus serrée vers les angles antérieurs, très serrée au milieu du sommet; angles antérieurs acuminés, nettement sinués au côté externe; septième strie des élytres courbe; ponctuation du pygidium beaucoup plus grosse que celle du thorax. Noir avec un léger reflet métallique sur le thorax. Epistome anguleux à sommet relevé, tête inerme sauf une très courte et

faible carène au niveau du bord postérieur des yeux; ponctuation fine et serrée, celle de l'épistome ridée. Thorax à deux plans inclinés vers les angles antérieurs, limités en arrière par un tubercule dentiforme situé vers les angles postérieurs; ces plans inclinés sont mats; base finement rebordée et bordée d'une ligne de points. Elytres à stries étroites, ponctuées, intervalles convexes à ponctuation très fine et écartée, obsolète sur les intervalles dorsaux. Metasternum presque lisse au milieu, marqué à l'arrière d'un sillon fovéiforme ♂. Forme générale d'*O. bakeri*. Longueur, 6,5 millimètres.

O. tagal sp. nov.

- 26 (9). Espèces à pubescence visible sur le thorax, au moins sur les côtes, et sur les élytres, au moins sur les côtés et le sommet.
- 27 (30). Espèces à longue villosité jaune. Carène frontale longue; thorax non rebordé à la base, ses angles antérieurs à côté externe rectiligne.
- 28 (29). Epistome parabolique, vertex muni d'une carène courte. Tête et thorax bronzés verdâtres, élytres noirs à tache humérale jaunâtre. Thorax fortement ponctué, avec une ligne longitudinale élevée, lisse, non sinué au côté externe des angles postérieurs; intervalles des élytres subconvexes, ridés, ponctués. Longueur, 4 millimètres..... *O. hirsutulus* Lansb.
- 29 (28). Epistome arrondi, subtronqué en avant, vertex armé de deux tubercules. Tête et thorax bronzés, parfois testacés; élytres noirs ou bruns avec des taches jaunes ou rougeâtres variables: généralement deux taches basales, une latérale et une apicale, parfois les taches basales sont réunies et envahissent toute la base sauf l'interstrie sutural. Carène frontale très longue, réunie aux sutures génales qui sont très courtes. Thorax convexe densément et assez fortement ponctué, nettement sinué au côté externe des angles postérieurs. Intervalles des élytres subconvexes à ponctuation râpeuse vaguement bisériée. Longueur, 4 à 5 millimètres..... *O. aereopictus* Bouc.
- 30 (27). Espèces non villeuses.
- 31 (58). Angles postérieurs du thorax nettement sinués au côté externe.
- 32 (37). Base du thorax nettement rebordée.
- 33 (34). Tête presque inerme, sans carène frontale, vertex muni de deux tubercules obsolètes situés un peu en arrière du bord antérieur des yeux. Brun concolore, cuisses plus ou moins rougeâtres; pubescence longue, jaune, écartée, sur les côtés du thorax et des élytres. Tête en ogive tronquée, densément ponctuée, yeux grands; thorax longuement déclive en avant, la déclivité limitée en arrière par une gibbosité médiane, angles antérieurs à côté externe rectiligne, angles postérieurs sinués, surface couverte d'une ponctuation fine, écartée, plus forte et plus écartée sur les côtés, une ligne régulière de gros points le long du rebord latéral, continuée le long de la base. Stries des élytres étroites, marquées de points transverses entamant les inter-

valles, toutes libres au sommet, la septième à peine sinueuse; intervalles dorsaux à ponctuation très fine et très écartée, l'intervalle latéral à points râpeux sétigères bien plus gros et plus serrés. Pygidium à gros points enfoncés peu serrés. Tibias antérieurs grêles terminés par un pinceau de polis dorés. Fémurs antérieurs munis au bord antérieur d'une carène bordée de gros points pilifères. Longueur, 7 millimètres.

O. cuneus sp. nov.

- 34 (33). Tête munie de cornes ou de carènes, jamais inerme; thorax à ponctuation serrée, non déclive en avant.
- 35 (36). Jaune citron, avec les rebords, les sutures, la base des élytres, les bords des cotyles d'un vert métallique, metasternum marqué de deux bandes longitudinales vertes, pygidium avec deux points bruns. Dessus à très courte et très fine pubescence jaune, dressée; entièrement et assez finement ponctué. ♂ Epistome anguleux, réfléchi, carène frontale obsolète, vertex armé, derrière les yeux, de deux cornes courtes et plates; thorax muni d'un lobe bifide obsolète, en avant. ♀ Tête à deux faibles carènes, celle du front rectiligne, non reliée aux sutures génales, celle du vertex sinuée et occupant la moitié de l'intervalle des yeux. Longueur, 5.5 à 8 millimètres..... *O. citreum* Bouc.
- 36 (35). Noir légèrement bronzé, élytres marquées d'une tache humérale et de quelques taches apicales rougeâtres peu apparentes; ponctuation plus fine et bien moins serrée. ♂ Epistome arrondi à sommet réfléchi, carène frontale nette, vertex armé, entre les yeux, de deux cornes courtes, droites, cylindriques; thorax rétus en avant. ♀ Carène frontale plus forte, carène du vertex haute et longue, occupant les deux tiers de l'intervalle des yeux; thorax muni d'un lobe anguleux obsolète. Longueur, 5 à 7 millimètres..... *O. gestroi* Har.
- 37 (32). Base du thorax non rebordée, sauf parfois au milieu.
- 38 (39). Pygidium non rebordé à la base; thorax renflé vers les angles postérieurs, couvert d'une ponctuation enfoncée. Noir, plus ou moins bronzé à pubescence jaune assez longue. ♂ Vertex armé de deux cornes courtes, arquées, reliées par une lame surélevée au milieu. ♀ Vertex avec une carène tridentée; thorax muni d'une carène transverse interrompue au milieu. Longueur, 7 à 11 millimètres..... *O. orientalis* Har.
- 39 (38). Pygidium rebordé à la base; thorax non renflé vers les angles postérieurs.
- 40 (43). Thorax armé de tubercules près du bord antérieur; élytres jaunes tachés de noir ou noirs tachés de jaune.
- 41 (42). Thorax avec trois tubercules. Bronzé cuivreux, élytres jaunes avec une fascie noire, l'intervalle sutural et une tache à la base du 5° intervalle noirs. ♂ Vertex armé d'une lame surmontée d'une petite corne. ♀ Vertex avec une carène longue. Longueur, 5, à 8 millimètres..... *O. trituber* Wied.

- 42 (41). Thorax avec deux tubercles. Bleu métallique sombre à pubescence jaune, courte, dressée; élytres marqués de taches jaunes: une humérale et deux autres confluentes sur les 2° et 4° intervalles. Epistome brièvement bidenté, carène frontale bidentée, vertex armé de deux dents aigües; thorax armé de deux dents en avant, angles antérieurs légèrement sinués au côté externe. Longueur, 5 millimètres²..... *O. sexdentatus* Bouc.
- 43 (40). Thorax inerme ou avec des tubercles placés loin du bord antérieur, ou encore chez les ♀ avec de petits tubercules transverses obsolètes.
- 44 (47). Elytres marquées de taches jaunes sur toute leur surface. ♂ Tête ogivale à sommet relevé sans carène frontale; angles antérieurs du thorax aigus.
- 45 (46). Mat, brun clair faiblement bronzé, pubescence courte; élytres marqués de nombreuses petites taches quadrangulaires flaves, interstries à ponctuation granuleuse serrée; pygidium plat. ♂ Tête très densément ponctuée, un petit tubercule entre les yeux; thorax à deux plans inclinés vers les angles antérieurs; tibias antérieurs à éperon très long. ♀ Carène frontale rectiligne, vertex avec deux tubercules transverses; thorax simple. Longueur, 7 millimètres..... *O. calcaratus* Bouc.
- 46 (45). Luisant, thorax vert métallique ou bronzé, élytres noirs marqués de quelques grandes taches rondes jaunes, ponctuation des intervalles faiblement râpeuse, le deuxième intervalle presque lisse; pubescence du thorax longue; pygidium convexe. ♂ Tête lisse sauf quelques points près des yeux; thorax conique avec un tubercule médian, angles antérieurs fortement sinués au côté externe. ♀ Tête avec deux carènes rectilignes très saillantes, atténuées au milieu, celle du vertex plus courte; thorax muni, en avant, d'un faible tubercule comprimé, angles antérieurs non sinués. Longueur, 5.5 à 8 millimètres. *O. pastillatus* Bouc.
- 47 (44). Elytres sans taches discales, soit concolores, soit avec des taches basales et apicales.
- 48 (49). Angles postérieurs du thorax avec un espace lisse. Coloration variable: tête et thorax brun bronzé, rarement testacé, élytres d'un brun plus ou moins foncé avec des taches basales flaves (la race de Palawan est d'un rouge cuivreux avec les élytres noirs sans taches). ♂ Tête armée sur le vertex d'une lame terminée en pointe, carène frontale nulle ou obsolète. ♂ Tête avec deux carènes, thorax avec deux petits tubercules transverses en avant. Longueur, 7 à 9 millimètres.
O. javanus Lansb.
- 49 (48). Angles postérieurs du thorax sans espace lisse.
- 50 (51). Ponctuation des intervalles dorsaux des élytres granuleuse. Peu luisant, noir, tête et thorax légèrement verdâtres, bords de l'abdomen plus ou moins rougeâtres; dessus densément

² Mr. G. J. Arrow m'a informé que ma description se rapporte à la ♀ d'une espèce dont le ♂ est armé à la base du thorax d'une corne longue et grêle.

et finement ponctué avec une pubescence assez courte, jaunâtre. Epistome en ogive obtuse, ses bords latéraux non sinués, carène frontale ♂ nulle, ♀ presque rectiligne et continuée jusqu'aux bords latéraux de la tête; carène du vertex rectiligne, placée entre les milieux des yeux dont elle occupe plus de la moitié de l'intervalle. Thorax ♂ armé de deux petits tubercules ponctiformes, en avant. Très voisin de *cer-vicapra* Bouc. dont il diffère par la pubescence, par la ponctuation granuleuse des élytres et par l'armature de la tête. La femelle pourrait être confondue avec celle d'*O. babirussa* var. *obscurior*, elle s'en distingue par l'absence de toute tache jaune, le thorax sans tubercule net et par l'armature de la tête. Longueur, 6 à 7 millimètres..... *O. eschscholtzi* sp. nov.

- 51 (50). Ponctuation des intervalles des élytres simple ou parfois finement râpeuse.
- 52 (53). Carène du vertex reliée aux sutures génales. Petit, ovale, convexe, métallique luisant, thorax bronzé ou vert, élytres verdâtres plus ou moins foncés. Thorax très convexe, densément ponctué. Elytres à stries fines, intervalles plats ridés et à ponctuation bisériée. Longueur, 3 millimètres..... *O. lilliputanus* Lansb.
- 53 (52). Sutures génales parfois reliée à la carène frontale, mais jamais à celle du vertex.
- 54 (55). Dessus mat. Testace ou brun clair, tête brune, thorax avec une grande tache discale brune plus ou moins étendue, stries des élytres généralement rembrunies. Parfois (var. *obscurior* Bouc.) noir avec les bords latéraux du thorax étroitement tachés de jaune, le disque verdâtre. Dessus à ponctuation très fine, carènes du prosternum écourtées et presque droites. ♂ Vertex armé de deux cornes plates. ♀ Tête avec deux carènes, thorax muni d'un bourrelet transverse en avant. Longueur, 6 à 8 millimètres *O. babirussa* Esch.
- 55 (54). Dessus luisant, front muni d'une gibbosité médiane, carènes du prosternum longues et sinueuses.
- 56 (57). Dessus à ponctuation assez forte, plus enfoncée et plus évasée, pubescence latérale plus étendue. Couleur variable: noir avec le thorax légèrement bronzé, élytres souvent roux. ♂ Tête anguleuse à sommet fortement relevé, sans carène, thorax à deux plans inclinés vers les angles antérieurs. ♀ Tête à deux carènes, l'antérieure atténuée à ses extrémités, accolée à la gibbosité, celle du vertex placée au niveau du bord postérieur des yeux. Longueur, 7 à 8 millimètres..... *O. bakeri* Bouc.
- 57 (56). Dessus à ponctuation fine, moins enfoncée et plus nette; pubescence latérale du thorax rare, celle des intervalles dorsaux des élytres limitée au sommet; gibbosité frontale plus faible. Noir, très luisant, dessous parfois brun clair. Elytres à stries peu marquées, la septième très sinueuse, intervalles plats à ponctuation obsolète, sauf sur l'intervalle latéral où elle est très nette et très dense. Pygidium scutiforme à ponctuation assez grosse et serrée. Mésternum finement sillonné et éparsement pointillé. ♂ Tête parabolique, les joues à peine saillantes,

- continuant la courbe de l'épistome; épistome à sommet perpendiculairement relevé en une lame anguleuse portant en avant, à sa base, une ligne transverse de points; toute la tête densément couverte d'une ponctuation assez fine, enfoncée, sans carène mais la base du vertex est relevée en buttoir. Thorax marqué, de chaque côté du milieu, d'une excavation longitudinale à fond presque lisse, déterminant une gibbosité médiane de forme subhexagonale dont les angles latéraux sont saillants en une grosse dent dirigée en dehors; au côté externe de l'excavation se trouve une petite dent dirigée vers la première. ♀ Tête suborbiculaire à sommet sinué, carène frontale fine, ne joignant pas les sutures génales, carène du vertex obsolète; ressemble beaucoup à *bakeri* ♀, en diffère par la courbe des bords latéraux de la tête sans sinuosité et par la ponctuation. Longueur, 6.5 à 7.5 millimètres..... *O. sibuyan* Bouc.
- 58 (31). Angles postérieurs du thorax non ou à peine sinués au côté externe.
- 59 (60). Epistome non incisé ni bidenté. Tête complètement inerme, finement pointillée. Thorax fortement rétus avec un lobe trapézoïdal échancré au sommet. Très luisant, noir, légèrement bronzé avec des taches diffuses rougeâtres aux côtés du thorax et autour des élytres; dessus densément et finement ponctué avec une pubescence extrêmement courte, à peine visible. Longueur, 7 millimètres..... *O. rasilis* Bouc.
- 60 (59). Epistome incisé ou bidenté.
- 61 (64). Thorax à ponctuation simple; dessus brun, mat.
- 62 (63). Thorax à ponctuation serrée. Brun clair avec des taches jaunes variables, généralement sur les côtés du thorax et le milieu de la base, à la base et au sommet des élytres, pygidium jaune avec deux points bruns, pattes jaunes. Elytres à ponctuation granuleuse serrée. ♂ Vertex armé d'une dent, front inerme, tibias antérieurs grêles, longs et courbés. ♀ Vertex avec un tubercule transverse obsolète, front avec deux carènes. Longueur, 5 à 6 millimètres..... *O. philippinensis* Bouc.
- 63 (62). Thorax à ponctuation écartée. Elytres à trois taches fauves latérales, et une apicale enfermant un point foncé, pygidium jaune marqué souvent d'un point brun, pattes brunes. Intervalles des élytres à ponctuation finement granuleuse bisériée. Tête ayant seulement une courte carinule oblique près de chaque oeil. Longueur, 4 millimètres..... *O. terminatus* Esch.
- 64 (61). Thorax à ponctuation ombiliquée, laissant le long de la base une étroite bande lisse, avec une ligne marginale de points; élytres à pubescence courte, sériée, de couleur claire, toutes les stries libre au sommet, la 7^e sinueuse. Epistome ♂ acuminé ou appendiculé, ♀ bidenté.
- 65 (66). Côtés de la tête nettement sinués à la jonction de l'épistome et des joues, surtout ♂. Thorax convexe à ponctuation ombiliquée assez grosse, profonde et homogène. Elytres à stries larges marquées de points transverses entamant les intervalles, ponctuation des intervalles peu nette, rugueuse. Pygidium à

grosse ponctuation ombiliquée, serrée et à pubescence dressée très courte. Tarses postérieurs courts et grêles. ♂ Epistome continué à son bord antérieur en un appendice recourbé en arrière, fortement élargi au sommet et bifurqué, plus long et plus grêle que chez *O. batillifer* Har., tête lisse et concave derrière l'appendice, front un peu gibbeux, joues à bords relevés. Thorax muni en avant d'un tubercule conique. ♀ Epistome échancré et bidenté, front avec une petite élévation transverse, obsolète, vertex muni d'une carinule courte, placée entre les milieux des yeux et dont les extrémités sont recourbées en avant. Thorax inerme. Brun de poix, la tête, les bords antérieur et latéraux du thorax, la base et le sommet des élytres souvent un peu rougeâtres, pygidium, bords de l'abdomen généralement rougeâtres. Longueur, 4 à 5 millimètres.

O. scepterifer sp. nov.

66 (65). Côtés de la tête non sinués, front inerme; ponctuation du thorax plus fine et plus serrée; vertex ♀ avec une petite ligne lisse, plus ou moins saillante, dont les extrémités sont recourbées en avant, chez les ♂, cette carène est nulle ou réduite à deux lignes obliques à peine sensibles, près des yeux, ♀ tête densément ponctuée.

67 (68). Intervalles des élytres à points simples, stries faiblement ponctuées. ♂ Epistome prolongé en un appendice en forme de T recourbe en arrière; thorax armé de deux petits tubercles très rapprochés l'un de l'autre, près du bord antérieur. Brun, élytres d'un testacé rougeâtre. Longueur, 4 millimètres.

O. lunulifer Bouc.

68 (67). Intervalles des élytres à ponctuation râpeuse ou granuleuse, stries fortement ponctuées, surtout les latérales. ♂ Epistome acuminé et relevé sans appendice³, thorax déclive en avant. Coloration brune avec des taches jaunes très variables, soit presque entièrement brune, soit presque entièrement testacée avec les stries brunes. Différent d'*O. deflexicollis* Lansb. par la taille plus petite, les côtés de la tête non anguleux, la ponctuation ombiliquée du thorax, les stries des élytres ponctuées et les intervalles à points granuleux ou râpeux.

69 (70). Stries dorsales des élytres nettement marquées de points assez grands, ronds, enfoncés, intervalles à ponctuation plus nettement granuleuse; pubescence dressée plus longue. ♂ Thorax armé d'un tubercule dentiforme, conique, au quart postérieur; le devant déclive. Longueur, 3.2 millimètres..... *O. zebu* Bouc.

70 (69). Un peu plus grand; stries dorsales à ponctuation moins enfoncée, ponctuation des intervalles râpeuse; pubescence dressée très courte. ♂ Thorax armé de deux tubercules latéraux, peu saillants, reliés par une arête courbe limitant la partie déclive qui occupe les $\frac{2}{3}$ antérieurs, sans tubercule médian. Longueur, 3.2 à 3.8 millimètres..... *O. unidens* Bouc.

³ Il est possible que les mâles bien développés aient un appendice, comme *O. batillifer* Har., mais je n'en ai pas vu.

CATALOGUE

Genus *ONTHOPHAGUS* Latreille

aereopictus BOUCOMONT, Ann. Soc. Ent. France 83 (1914) 326. Décrit des Iles Philippines.

LUZON, Los Baños (*Baker*); Mount Maquiling (*Baker*); Mount Banahao (*Baker*). BORNEO, Sandakan (*Baker*); BANGUEY; Singapore (*Baker*).

armatus E. BLANCHARD, Voyage au Pôle Sud (1853) 98, pl. 7, figs. 9, 10; BOUC., op. cit. 305; BOUC. in Vitalis, Faune Indochine 4 (1921) 29, 52. Décrit de Bornéo, cité de l'Archipel Malais et d'Asie Orientale.

luzonicus LANSBERGE, Notes Leyden Mus. 5 (1883) 44.

LUZON, Manille; Los Baños (*Baker*); Mount Maquiling (*Baker*).

babirussa ESCHSCHOLTZ, Entomogr. 1 (1822) 33. Décrit de Luzon. BOUC., op. cit. 294, cité de l'Archipel.

LUZON, Mount Banahao (*Baker*); Mount Maquiling (*Baker*); Baguio, Benguet (*Baker*); MINDANAO, Iligan (*Baker*); Surigao (*Baker*); Cagayan (*Baker*); BASILAN (*Baker*).

var. *obscurior* BOUC., loc. cit. Décrit de Bornéo.

LUZON, Mount Maquiling (*Baker*).

baëri BOUC., Ann. Soc. Ent. Fr. 83 (1914) 307. Décrit de Davao.

MINDANAO, Davao; Iligan (*Baker*).

bakeri BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 312. Décrit de Luzon.

LUZON, Los Baños (*Baker*); Mount Banahao (*Baker*); Mount Maquiling (*Baker*).

bangueyensis BOUC., Ann. Soc. Ent. Fr. 83 (1914) 323, ♂ minor et ♀, décrit de l'île Banguay. ♂ major, décrit ci-dessus.

PALAWAN, Binaluan (*G. Boettcher*).

calcaratus BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 316, ♂; Bull. Soc. Ent. Fr. (1921) 92, ♀.

MINDANAO, Dapitan (*Baker*).

citreum BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 312.

LUZON, Mount Maquiling (*Baker*); Mount Banahao (*Baker*).

cuneus sp. nov.

PALAWAN, Binaluan (*G. Boettcher* 1913).

dapitanensis BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 318.

MINDANAO, Dapitan (*Baker*).

eschscholtzi sp. nov.

PALAWAN, Binaluan (*G. Boettcher*).

galeatus BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 315, ♂; Bull. Soc. Ent. Fr. (1921) 92, ♀.

var. *sus* BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 317; Bull. Soc. Ent. Fr. (1921) 92.

MINDANAO, Iligan (*Baker*); Dapitan (*Baker*); Kolambugan (*Baker*); Surigao (*Baker*); Tangkulan, Bukidnon (*Baker*); BASILAN (*Baker*).

gestroi HAROLD, Ann. Mus. Civ. Genova 10 (1877) 59; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 304, 305. Décrit des Célebes et de Sumatra, cité de Saleyer, Sumbawa, et Tenimber.

LUZON, Los Baños (*Baker*); Mount Maquiling; MINDANAO, Surigao (*Baker*); Sibuyan. BORNEO, Sandakan (*Baker*).

hirsutulus LANSBERGE, Notes Leyden Mus. 5 (1883) 67; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 324, 325. Décrit de Java, cité de Sumatra. MINDANAO, Surigao (*Baker*).

inermivertex BOUC., Bull. Soc. Ent. Fr. (1921) 90. MINDANAO, Iligan (*Baker*); Dapitan (*Baker*).

javanus LANSBERGE, op. cit. 55; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 287, 291. Décrit de Java, cité de Sumatra.

var. à élytres noirs, thorax rouge cuivreux.

PALAWAN, Binaluan (*Boettcher*). BORNÉO, Pontianak (coll. R. Oberthür); Doesonlanden (ex coll. N. van de Poll).

lilliputanus LANSBERGE, op. cit. 69; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 280, 284. Décrit de Java, cité de Sumatra et Bornéo. Une variété se rencontre dans l'Inde.

LUZON, Los Baños (*Baker*); Mount Banahao (*Baker*); MINDANAO, Butuan (*Baker*).

lunulifer BOUC., Ann. Soc. Ent. Fr. 83 (1914) 309.

LUZON, Los Baños (*Baker*) coll. J. Gillet; Mount Maquiling (*Baker*); Mount Banahao (*Baker*).

orientalis HAROLD, Coleopt. Hefte 4 (1868) 83; SHARP, Col. Hefte 14 (1875) 56; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 299; BOUC., in Vitalis, Faune Indoch. 4 (1921) 34, 54. Décrit de Hong Kong et du Bengale, cité de l'Archipel Malais et de l'Asie Orientale.

PALAWAN (ex coll. van de Poll).

pastillatus BOUC., Ann. Soc. Ent. Fr. 83 1919 (1920) 318, ♂; Bull. Soc. Ent. Fr. (1921) 92, ♀

MINDANAO, Iligan (*Baker*). BORNÉO, Sandakan (*Baker*); Martapura (*Doherty* 1891); Mount Matang, W. Sarawak (*G. E. Bryant*) coll. du British Museum.

philippinensis BOUC., Ann. Soc. Ent. Fr. 83 1919 (1920) 313.

LUZON, Mount Banahao (*Baker*); MINDANAO, Iligan (*Baker*); SIBUYAN.

pilularius LANSBERGE, op. cit. 71; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 276, 277. Décrit de Java, cité de Sumatra et Bornéo.

PALAWAN (ex coll. van de Poll.)

praedatus HAROLD, Berlin. Ent. Zeitschr. 6 (1862) 403 nomen nudum; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 307.

verticalis BOHEMAN, Freg. Eugen. Resa (1858) 44. Décrit de Manille.

LUZON, Los Baños (*Baker*); Mount Banahao (*Baker*); Mount Maquiling (*Baker*); MINDANAO, Butuan (*Baker*).

rasilis BOUC., Bull. Soc. Ent. Fr. (1921) 91.

MINDANAO, Iligan (*Baker*).

rudis SHARP, Col. Hefte 14 (1875) 58; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 271; BOUC., in Vitalis, Faune Indoch. 4 (1921) 35, 41. Décrit du Siam, cité de Java, Bornéo, Sumatra, Nias, Lombock, Malacca, Darjiling, et d'Indochine.

asper SHARP, op. cit. 59 (Célebes).

foveolatus HAROLD, Ann. Mus. Civ. Genova 10 (1877) 68. Bornéo.

LUZON, Los Baños (*Baker*); Mount Maquiling (*Baker*); MINDANAO, Surigao (*Baker*); Davao (*Baker*); Dapitan (*Baker*); Kolambugan (*Baker*); PALAWAN, Bacuit (*Boettcher*).

scepterifer sp. nov.

PALAWAN, Bacuit (*Boettcher*).

semiaureus LANSBERGE, Notes Leyden Mus. 5 (1883) 75; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 275. Décrit de Java et Sumatra, cité de Bornéo et Célebes.

PALAWAN (ex coll. van de Poll).

semicupreus HAROLD, Ann. Mus. Civ. Genova 10 (1877) 81; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 277. Décrit de Bornéo, cité de Java et Malacca.

PALAWAN, Bacuit (*Boettcher*).

sexdentatus BOUC., Ann. Soc. Ent. Fr. 88 1919 (1920) 319.

LUZON, Mount Banahao (*Baker*).

sibuyanus sp. nov.

SIBUYAN (*Baker*).

tagal sp. nov.

SIBUYAN (*Baker*).

terminatus ESCHSCHOLTZ, Entomogr. (1822) 32; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 318, 322. Décrit de Luzon.

LUZON, Mount Maquiling (*Baker*).

trituber WIEDEMANN, Zool. Mag. 2, 1 (1823) 17; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 286, 289; BOUC., in Vitalis, Faune Indoch. 4 (1921) 37, 50. Décrit de Java, cité de Sumatra, Amboine, Tonkin, et Formose.
suturalis WHITE, Ann. Nat. Hist. I 13-14 (1844) 424. Décrit de Hongkong.

La présence de cette espèce aux îles Philippines est douteuse; j'ai cependant rencontré dans une collection qui m'a été communiquée, quelques exemplaires portant des étiquettes de cette provenance.

unidens BOUC., Ann. Soc. Ent. Fr. 83 (1914) 308, note I.

LUZON, Los Baños (*Baker*); Mount Maquiling (*Baker*); Mount Banahao (*Baker*).

wallacei HAROLD, Col. Hefte 8 (1871) 114; BOUC., Ann. Soc. Ent. Fr. 83 (1914) 266. Décrit des Célèbes, cité des îles Aru, Amboine, Saley, Ternate, et de Java.

ovilis SHARP, Col. Hefte 14 (1875) 59.

simulans SHARP, op. cit. 60.

var. *fraternus* LANSBERGE, Notes Leyden Mus. 5 (1883) 42.

var. *mindanaensis* BOUC., Ann. Soc. Ent. Fr. 83 (1914) 268.

MINDANAO, Dapitan (*Baker*); Davao; MINDORO.

zebu BOUC., Bull. Soc. Ent. Fr. (1921) 89.

MINDANAO, Kolambugan (*Baker*); Dapitan (*Baker*); Bukidnon, Tangkulan (*Baker*).

DISTRIBUTION OF TRUE FRESH-WATER FISHES IN THE PHILIPPINES, II

THE PHILIPPINE LABYRINTHICI, CLARIIDÆ, AND SILURIDÆ

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TWO PLATES

This paper completes a survey of the strictly fresh-water Philippine fishes, within the limits set in the introduction to Part I.¹ The remaining species are few; namely, dalag, climbing perch, two catfishes of general or wide distribution, and one, highly localized osphronemid. Any further discussion of the fishes found in the rivers and lakes of the Philippines, unless limited to single species or genera, would necessitate a consideration of forms dwelling largely in brackish or salt water and is therefore omitted. One order, including three families, and two families belonging to the order of catfishes, with two new genera and two new species, are here presented.

In this paper the length recorded does not include the caudal fin, except where so stated.

Order LABYRINTHICI

An assemblage of fishes, either perchlike with oblong and compressed, or elongate and more or less cylindrical body, characterized especially by the presence of a large cavity in the head above the gills. The latter is a peculiar modification of the upper elements of one of the pairs of gill-bearing arches. Instead of the branchiyls being straight and solid, as in most fishes, they are excessively developed and in all except the Ophicephalidæ are provided with several thin plates or folds, erect from the surface of the bones and the roof of the skull. These by their intersection form an elaborate apparatus or labyrinth of thin plates and chambers lined with a vascular membrane well supplied with large blood vessels. Into the suprabranchial cavity atmospheric air is taken direct, the fish rising to the

¹ Philip. Journ. Sci. 24 (1914) 249 to 307.

surface for the purpose of inhaling the air; if prevented from so doing it dies of suffocation, the gills alone apparently not being able sufficiently to oxygenate the blood. The suprabranchial chamber communicates with the branchial cavity by an opening above the two anterior gill slits, and may be separate from the pharyngeal cavity or in open communication with it, as in the *Ophicephalidæ*.

Scales large to medium in size, ctenoid or cycloid; lateral line present and continuous or interrupted, vestigial, or absent; dorsal fin single, long, origin above or before base of pectorals and longer than anal, or shorter than anal and beginning behind base of pectorals; dorsal and anal with numerous spines of variable number or spines absent; ventrals thoracic, sub-abdominal, of six rays, the outer spinous in Philippine species; gills four; pseudobranchiæ none or rudimentary; pyloric appendages few or none; air bladder present or absent.

This order is confined to the fresh waters of the East Indies, southeastern and southern Asia, and tropical Africa. The various species have the power of being able to live out of the water for some time, or to live in semifluid mud, or even to lie in a half-torpid condition in the thick mud beneath the hard-baked crust of the bottom of a pond or water hole. They are not able, however, to live in mud from which all moisture has disappeared, as popular superstition credits them to be; when their gills are entirely dry they die as do other fishes.

Key to Philippine families of Labyrinthici.

- α^1 . Dorsal and anal without spines, of jointed rays only; scales cycloid; no labyrinthiform organ in suprabranchial cavity..... *Ophicephalidæ*.
- α^2 . Dorsal and anal with one to many spines; scales ctenoid; suprabranchial cavity with a labyrinthiform organ.
 - b^1 . Fixed conical teeth on palatines and jaws; vomer toothless; first soft ray of ventral produced into a single filament, or ventral reduced to a single long filament..... *Osphronemidæ*.
 - b^2 . Fixed conical teeth on vomer and jaws; none on palatines in Philippine representatives; ventrals of one spine and five soft rays.

Anabantidæ.

OPHICEPHALIDÆ

Elongate and more or less cylindrical fishes, the posterior portion strongly compressed laterally; head large, depressed, covered above with very large shieldlike scales, those of the rest of the body of medium size, cycloid and much striated; all the fins lack spines; dorsal and anal long, undivided, with many

rays, the pectorals large and the ventrals thoracic when present; the pelvic bones attached to the symphysis of the clavicles by a ligament; mouth large, upper lip protractile, though I have never seen a living fish extend it; maxillaries outside margin of mouth, bands of small or cardiform curved teeth on intermaxillaries, vomer, palatines, and mandibles; canine teeth also always present on mandibles and sometimes on vomer and palatines; lateral line nearly always curved more or less abruptly in its anterior half or may be partially interrupted; air bladder continued into an elongation of abdominal cavity in tail; four gills; gill rakers present but no pseudobranchiæ; gill membranes connected with each other but free from isthmus.

Above the gills is a large cavity, connected with the throat and serving as an accessory breathing organ. These fish go to the top and inhale air directly, the osmotic transfer of gases taking place through the mucous membrane that lines the cavity. In this way they are able to live in imperfectly oxygenated water or in mud, and to endure prolonged removal from water. Their position in the water is indicated by the bubbles which they expel at frequent intervals. So dependent are they upon the oxygen derived from directly inhaled air that they drown if kept in a vessel where they are prevented from coming to the surface of the water now and then.

This family includes two genera, and occurs from Formosa and Halmahera to Hindustan, Ceylon, and tropical Africa. But one occurs in the Philippines.

Key to the genera of Ophicephalidæ.

- a*¹. With ventral fins and two pyloric appendages..... *Ophicephalus*.
*a*². Without ventral fins or pyloric appendages..... *Channa*.

Genus *OPHICEPHALUS* Bloch

Ophicephalus BLOCH,² Ausland. Fische 7 (1793) 137. Type *Ophicephalus punctatus* Bloch.

Ventral fins are present and there are two long pyloric appendages. In other respects the characters are as given under the family Ophicephalidæ.

Key to the species of Ophicephalus said to occur in the Philippines.

*a*¹. Scales on top of head large.

*b*¹. Four to five scales in transverse series from anterior part of dorsal to lateral line; dorsal 37 to 43; anal 21 to 27.

*c*¹. Pectorals shorter than head behind eyes; lateral line 52 to 57.
O. striatus.

² Name altered by subsequent authors to *Ophiocephalus*.

- c². Pectorals about as long as head behind eyes; lateral line 50 to 52.
O. melasoma.
 b². Three to three and one-half scales in transverse series from anterior
 part of dorsal to lateral line; dorsal 44 to 47; anal 28 to 31; head
 3.5 to 3.8 times in length..... O. melanopterus.
 a². Scales on top of head small..... O. maculatus.

Of the four species given in the key I have found but one in the Philippines. *Ophicephalus melanopterus* was recorded by Smith and Seale from Cotabato, Mindanao, but I have no doubt that their specimens were really *O. striatus*. Kner recorded *O. maculatus* among the fishes obtained by the Novara Expedition at Manila, but unquestionably this species does not occur in the Philippines, least of all at Manila. If there was no error in identification the material came from China, from whence alone this species is positively known.

Ophicephalus melasoma Bleeker.

Ophicephalus melasoma BLEEKER, Nat. Tijdschr. Ned. Indië 2 (1851) 424.

Ophiocephalus melanosoma GÜNTHER, Cat. Fishes Brit. Mus. 3 (1861) 473; BLEEKER, Atlas Ichth. 9 (1877) pl. 399, fig. 4; BOULENGER, Ann. & Mag. Nat. Hist. VI 15 (1895) 186; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 4 (1922) 319.

Dorsal 37-41; anal 21-25; pectoral 14-15; ventral 6; lateral line 50-52; scales in transverse series $\frac{4-4\frac{1}{2}}{8-9}$.

Depth 5 to 5.8, and 5.9 to 7.2 in length with caudal; head 3.1 to 3.3, and 3.8 to 4.2 in length with caudal; eye 5.7 to 7 in head, twice or a little less in interorbital space.

Cylindrical anteriorly, compressed posteriorly, head depressed, its upper profile straight, and interorbital space flat; snout less than twice diameter of eye; maxillary reaching from hind border of eye to far beyond eye; lower jaw slightly prominent, cleft of mouth rather oblique; a rather broad villiform band of teeth in intermaxillaries, teeth near angle coarser, especially the posterior ones; a patch of moderately strong teeth on vomer and an elongate band of strong teeth on palatines, the inner row largest and caniniform; several rows of teeth near symphysis of lower jaw, passing into a single row at sides, behind which are strong, widely spaced canines, all teeth curved backward; five or six scales in a row between eye and hind border of operculum and three to four rows on operculum; lateral line with an abrupt downward curve of three scales at fourteenth or fifteenth scale; fifteen to sixteen scales between tip of snout and origin

of dorsal, which is behind base of pectorals; dorsal extends beyond tip of anal; pectorals about as long as from eye to posterior margin of head; ventrals as in *O. striatus*.

Color in alcohol dark greenish or bluish above, yellowish or reddish brown below; a rather inconspicuous dark oblique spot behind corner of mouth; underparts of head sometimes with yellow spots; pectorals, dorsal, and caudal dark, ventrals of the color of the lower parts, sometimes striped posteriorly; anal light, with a subterminal dark band. Attaining a length of 285 millimeters.

This species is included on the authority of Boulenger, who determined as such three specimens collected by Everett on Balabac Island. I have seen no material, the above description being compiled from Weber and Beaufort.

As in *O. striatus*, young specimens have a red lateral band from snout to caudal.

Ophicephalus melasoma occurs in the East Indies on the islands of Sumatra, Banca, and Borneo, and in Tonquin and Siam on the mainland.

Ophicephalus striatus Bloch.

Ophicephalus striatus BLOCH, Ausland. Fische 7 (1793) 141, pl. 359; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 313, pls. 202 and 206.

Ophiocephalus striatus GÜNTHER, Cat. Fishes Brit. Mus. 3 (1861) 474; BLEEKER, Atlas Ichth. 9 (1877) pl. 399, fig. 1; SMITH, Bull. U. S. Fish Comm. 21 (1901) 171; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 782; Bull. U. S. Bur. Fisheries 26 (1906) 27; EVERMANN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) 103; Proc. U. S. Nat. Mus. 31 (1907) 507; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 4 (1922) 317.

Ophiocephalus vagus PETERS, Monatsber. Akad. Berlin (1868) 260.

? *Ophiocephalus melanopterus* SMITH and SEALE, Proc. Biol. Soc. Washington 19 (1906) 79.

Dalag in Tagalog and many other Philippine dialects; *aluan* or *haluan* and *aruan* or *haruan* in Moro and Visayan; *haroan*, *torabó*, *terebug*, and *talosog* in Bikol; *bakule* and *bulig* are Tagalog names applied to young *dalag*.

Dorsal 37-43; anal 23-27; pectoral 15-17; ventral 6; lateral line 52-58; scales in transverse series $\frac{4}{8-10}$, not counting the lateral line.

Depth 5 to 6, head 3 to 3.3 in length without caudal, and 3.6 to 4 in total length; eye 4.4 to 8.5 in head, 1.6 to 2 in inter-orbital space, and 1.2 to 1.75 in snout.

The large broad head flat between eyes, upper profile but little convex, being more like an inclined plane; trunk hardly cylindrical but more or less flattened on sides even just behind head and strongly compressed posteriorly; eyes large, prominent, and somewhat projecting in life; the slightly oblique mouth large, the maxillary reaching well beyond eye, except in the very young (in a specimen 32 millimeters long it extends but a little beyond pupil); snout broad, rounded, lower jaw projecting; teeth in upper jaws (intermaxillaries) very small, recurved, in broad bands, tapering posteriorly, of from five or six to eight or nine rows, those behind symphysis fewer, coarser, longer, and some of them caninelike; teeth on vomer and palatines in about three or four rows, much larger than those on intermaxillaries, recurved, palatine teeth larger than those of vomer, some of them caniniform; teeth of mandibles in a patch of from three to five rows of teeth near symphysis, posteriorly with but one row of widely spaced canines larger than any of the other teeth in either jaw; pectorals shorter than postorbital part of head; lateral line with a downward curve, usually including three scales, at sixteenth to twentieth scale.

Color of specimens in alcohol above greenish or bluish to almost black, becoming white, silvery, or brownish beneath; dark streaks and blotches both above and below, including dorsal and anal fins and forming diagonal bars running forward and meeting at right angles on sides, these obscured or obsolete in old specimens; undersurface white, with dark or brown dots, dashes, and irregular or curved spots; a dark stripe from angle of mouth to suboperculum, sometimes fading and disappearing; pectorals dark, like the back; ventrals pale to whitish, spotted with dark brown or posterior half dark like the back; caudal very dark, or with crossbars of light and dark.

Color in life of a specimen raised from the egg, in my office. 375 millimeters long over all, pale muddy or brownish gray above and on sides with darker mottlings on head and dark brown bands or blotches across back and passing diagonally downward and forward to middle of side, where they may meet at right angles more or less clearly defined similar bars from below or be continued downward stopping at the white of belly and underparts, which are spotted with dark brown; a dark bar from corner of mouth backward and downward to opercle; dorsal fin clear to muddy, with flecks of brown; pectorals and ventrals colorless, with a few dark spots; anal and

caudal very dark with a bronze greenish cast; eyes large, very prominent, with orange red iris.

Dalag is the most important fresh-water food fish in the Philippines, and occurs in lakes and lowland rivers throughout the islands from Siasi northward. While I have examined vast numbers of specimens from Jolo to Aparri, it is apparent that the original habitat of this fish did not include all the Philippine waters in which we now find it. Dalag abound in Lake Lanao but it is very evident that they have been planted there by the Moros. The Tagabilis claim to have taken them to Lake Sebu in the high mountains of southern Cotabato Province, while we know positively that they were carried by Christian Filipinos from Laguna de Bay, Luzon, to Lake Balinsasayao, the name applied to two small crater lakes at an altitude of about 1,050 meters in Oriental Negros, near Dumaguete. In like manner dalag have been distributed to lowland rivers and ponds all over the Islands, until they now occur wherever they can maintain themselves.

No systematic attempts have been made to cultivate dalag, though some of the Ifugaos stock their rice paddies with the fry and harvest them a few months later, while now and then some person attempts to grow them in a natural or artificial pond. The greatest obstacle to growing dalag commercially is their carnivorous habit and the difficulty of obtaining any cheap animal food in the Philippines. If this obstacle could be overcome they could be grown easily in large numbers.

Dalag are monogamous and reproduce during every month in the year in the Philippines, while unquestionably many, if not all, breed twice a year. The eggs are laid in a nest of water plants, usually some species of alga, in the center of which they float, lying flush with the surface of the water. They are of a golden yellow color, about a millimeter in diameter, and from five hundred or so to perhaps a few thousand in number.

One or other of the parents guards the nest at all times, lying concealed beneath it. The eggs hatch in two or three days and the fry swim about in a dense mass, protected by one or both parents, a single individual hardly visible except for its golden eyes. In a short time the fry assume a characteristic orange color and are very handsome lively little fish, incessantly journeying up and down in the water and emitting bubbles of air as they come to the surface. As they grow larger their color changes and the orange remains only as a longitudinal lateral stripe. The school remains together until the fry reach a length

of 50 or 60 millimeters or more, always continuing the habit of coming to the top for air and diving beneath, but no longer doing so in unison, and more and more separating from each other.

As time goes on their numbers become greatly diminished. Of the original eggs, many do not hatch owing to the attacks of water fungi; while fungi, various parasites both internal and external, insects and insect larvæ, crustaceans, birds, and other fishes levy toll upon the fry. If food is scarce the adults gobble the young dalag as quickly as any other morsel.

With increased size the school scatters, each fish taking up a solitary abode, and the colors turn to brownish, with darker, diagonal, angled crossbars and a conspicuous dark ocellus at the posterior end of the dorsal; this gradually fades and the adult color and markings are assumed before the fish are a year old.

I have grown many in my office, and find that they become sexually mature in about eighteen months, when they may have a length of 250 millimeters or more. Specimens of the same age grown in ponds are much larger, however. As previously noted, one specimen raised in my office attained a length of 375 millimeters in two years and three months. Although this species is said by Weber and Beaufort to reach a length of over 900 millimeters, I have never seen any in the Philippines more than about 600 millimeters long. Such large, bulky specimens are several years old and are rare except in places such as Lake Lanao, Lake Balinsasayao, Liguasan marsh, or the overflow lakes of the Agusan Valley. In the vicinity of Manila they are fished for too constantly to reach any very great size.

Dalag are very hardy and are able to survive conditions fatal to most other kinds of fishes. They are able to endure prolonged removal from the water, and during rains voluntarily make long journeys across wet grassy or muddy ground, or along tiny rills or wet paths. In this way they reach isolated pools and flooded rice fields, although usually they reach the latter by following the irrigation ditches. Unobservant people, finding them in rice paddies which a few days before were dry and hard, have spread wide the delusion that they were buried in the sun-baked mud during the dry season or have rained down.

When the water has been drawn off or has evaporated until there remains but a pool of liquid mud, dalag are still able to survive for a long time, burrowing down in the mud for a foot

or two; even after the surface of the mud has been caked over they will live as long as it is moist beneath.

Dalag take the hook readily, frogs being a particularly attractive bait. Large numbers are also taken in swamps and rice paddies by the aid of a conical woven trap, open at both ends, with the ribs projecting at the larger end for several inches. The person using it wades about, keeping a sharp lookout for bubbles of air which betray the presence of a dalag beneath. When these are seen the trap is plunged down into the mud over the spot where the bubbles were observed and, by feeling about with the hand in the inclosed space, the fish is forthwith caught.

Although foreigners usually have a violent prejudice against eating dalag, they are really good food when properly prepared and have the great merit of being strictly fresh, since in most markets they are kept alive until sold, the market women having to stun them with a club before the customer can carry them readily.

Owing to their voracity, rapid reproduction, and quick growth, they play great havoc upon gaining entrance to ponds or preserves stocked with other fishes. Anyone engaging in the culture of other fresh-water fishes must be sure that there are no dalag left in the water to be stocked, and care must be taken that none can get in later.

Dalag occur from Ceylon and Hindustan east to Flores, Amboina, Batjan, and Halmahera, and northward to southern China, from whence they were introduced into Oahu Island; they are common about Honolulu. I have no doubt that their extension in the East Indies eastward beyond Lombok has been due wholly to man's agency, while it is most probable that Borneo and Mindanao mark the limit of their natural range.

OSPHRONEMIDÆ

Compressed or strongly compressed, oblong to elongate, often very broad fishes, without teeth on the palate and with the first soft ray of each ventral produced into a single elongated filament; the ventral may consist of a spine and five rays, or may be reduced to a single filamentous ray and a rudimentary spine; lateral line complete and continuous or interrupted, vestigial, or absent; scales moderate to large, ciliate; dorsal shorter than anal, its origin behind or above that of anal; origin of ventrals below or in advance of the pectorals.

Fresh-water fishes of the East Indies and tropical Asia and Africa, many of them very small, and noted for their beauty or their pugnacity. One, the gourami, attains a large size and is celebrated for its excellent flavor; it is the best of all Asiatic tropical food fishes. It has been introduced into many parts of the world and would be a valuable addition to the fish fauna of the Philippines, since it thrives under pond culture.

Genus **TRICHOGASTER** Bloch and Schneider

Trichogaster BLOCH and SCHNEIDER, Syst. Ichth. (1801) 164; type as restricted by Cuvier & Valenciennes, *Labrus trichopterus* Pallas.

Trichopodus LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 129: (*trichopterus*).

Trichopus SHAW, Gen. Zool. 4 (1803) 392: emendation: same type.

Body strongly compressed and oblong; mouth very small, very oblique, the somewhat protractile upper jaw vertical when at rest, lower jaw prominent; bands of minute fixed teeth in both jaws, a few larger ones in outer row; preorbital and preopercle strongly spinous, lower margin of subopercle serrate; opercle terminating in a membranous posterior flap; dorsal much shorter than anal, with three to eight spines and eight to eleven rays; origin of anal about below base of pectorals, with nine to fourteen spines and twenty-five to thirty-nine rays, extending to base of caudal and with a wide basal scale sheath; origin of ventrals in advance of pectorals, composed of a vestigial spine, a greatly elongated simple filament which is the modified first ray, and two or three rudimentary rays; lateral line complete but more or less curved and irregular; scales of moderate size, diagonally and more or less irregularly arranged.

Small fishes of the East Indies from Sumatra to Borneo and occurring also in Cochin China, Siam, and the Malay Peninsula.

Trichogaster trichopterus (Pallas). Plate 1.

Labrus trichopterus PALLAS, Spicil. Zoolog. 8 (1777) 45.

Trichopodus trichopterus LACÉPÈDE, Hist. Nat. Poiss. 3 (1802) 125 and 129; BLEEKER, Atlas Ichth. 9 (1877) pl. 395, fig. 4; REGAN, Proc. Zool. Soc. London (1909) 783; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 4 (1922) 366, fig. 93.

Trichopus trichopterus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 290, pl. 199.

Osphromenus insulatus SEALE, Philip. Journ. Sci. § A 4 (1909) 530.

Dorsal VI–VIII, 7–10; anal X–XII, 30–38; lateral line 30–40.

Depth 2 to 2.6, head 2.7 to 3.2 (3.4) in length; head somewhat pointed, upper profile straight or slightly concave; diameter of eye equal to or much more than length of snout, $3\frac{1}{8}$ to 3.6 in head; pectoral as long as head; dorsal short, its origin over the

spinous anal, its basal length equal to or less than distance from posterior end of dorsal base to base of caudal; ventral filament extending to caudal base; lateral line curved, irregular, more or less broken, with thirty-one to thirty-four tubule-bearing scales in our specimens.

Color in life brown with some irregular blackish marks on shoulders, some yellowish on opercles and on thorax, some vivid pink at base of anal, * * *. Dorsal yellowish brown in females, brown in males, the rays marked with yellowish dark-ringed spots. Caudal brown, with numerous yellowish spots, anal brown with some yellowish spots, pectorals brown, ventrals yellowish, a distinct black spot at base of caudal, another on middle of side.—*Seale*.

Color in alcohol dull dark brown, becoming paler on sides and silvery on breast, with many pale, irregular, narrow, somewhat diagonal crossbands on sides; a large black spot surrounded by a pale area on middle of side and a similar one at base of caudal; caudal and posterior half of anal with alternate series of pale and dark spots; soft dorsal with similar, very faint spots.

Here described from twelve specimens, 30 to 64 millimeters in length, collected by Alvin Seale in 1908 from a small crater lake on Cagayan Sulu. Since none of them is mature the specimens differ somewhat in detail from larger specimens. None of them has over thirty-three rays in the anal, while the eye is relatively much larger than in adults, in which it is about 4.5 times in the head.

This species, which reaches a length of 120 millimeters, occurs from Singapore and Sumatra to Borneo and Bali, and on the mainland in Cochin China, Cambodia, Siam, Penang, and throughout the Malay Peninsula.

ANABANTIDÆ

Body oblong, compressed, with broad to very broad head; preorbital, operculum, suboperculum, and interoperculum serrated, or denticulated; the small, oblique mouth extends to below eye; teeth small, conical, fixed, in bands on jaws and vomer, and in one genus on palatines; scales large, regularly arranged, ciliate; dorsal with sixteen to twenty spines and seven to eleven rays; anal with eight to eleven spines and eight to twelve rays; spinous portion longer than soft dorsal and anal, the rays scaled basally; pectorals and caudal rounded; ventrals thoracic, inserted behind pectorals, with one spine and five rays, none of them elongated; cæcal appendages none to three.

Two genera, one in the East Indies and tropical Asia, the other in tropical Africa.

Genus **ANABAS** Cuvier

Anabas CUVIER, Regne Anim. ed. 1a (1817) 339.

This genus is separated from *Ctenopoma* by the absence of teeth on the palatines; in other respects the characters are sufficiently defined above.

Found in the fresh waters of the lowlands throughout southern and southeastern Asia and the adjacent islands, from Ceylon and Hindustan to southern China, Batjan, and Halmahera.

Anabas testudineus (Bloch).

Anthias testudineus BLOCH, Ausland. Fische 7 (1795) 121.

Perca scandens DALDORFF, Trans. Linn. Soc. 3 (1797) 62.

Anabas testudineus CUVIER, Regne Anim. ed. 1a 2 (1817) 310; PETERS, Monatsber. Akad. Wiss. Berlin (1868) 259; BLEEKER, Atlas Ichth. 9 (1877) pl. 396, figs. 2 and 3, Mem. Poiss. Pharyng. Labyrinth., Nat. Verh. Kon. Akad. 19 (1879) 7; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 782; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) 262; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 4 (1922) 344, figs. 2 and 3.

Anabas scandens CUVIER and VALENCIENNES, Hist. Nat. Poiss. 7 (1831) 249, pls. 193, 205, and 206; GÜNTHER, Cat. Fishes Brit. Mus. 3 (1861) 375; SMITH, Bull. U. S. Fish Comm. 21 (1901) 170; SMITH and SEALE, Proc. Biol. Soc. Washington 19 (1906) 79; REGAN, Proc. Zool. Soc. London (1909) 771.

Anabas macrocephalus BLEEKER, Nat. Tijdschr. Ned. Ind. 7 (1854) 430; GÜNTHER, Cat. Fishes Brit. Mus. 3 (1861) 376.

Anabas oligolepis BLEEKER, Nat. Tijdschr. Ned. Ind. 8 (1855) 161; GÜNTHER, Cat. Fishes Brit. Mus. 3 (1861) 376; BLEEKER, Atlas Ichth. 9 (1877) pl. 395, fig. 5.

Anabas microcephalus BLEEKER, Act. Soc. Sc. Indo-Neerl. 2 (1857) 58; GÜNTHER, Cat. Fishes Brit. Mus. 3 (1861) 377; BLEEKER, Atlas Ichth. 9 (1877) pl. 395, fig. 2.

Climbing perch; *martinico* in Filipino Spanish; *martinik* and *tinikan* in Tagalog; *liwaló* in Pampangan; *araró* in Ilocano; *gután* in Visayan; *puyo* in Bicol; *puyo* in Maguindanao Moro and *puyo* or *puyo-puyo* in Manobo, Bagobo, Mandaya, and other Mindanao languages; *piit* in Tao Sug or Joloano Moro.

Dorsal XVI-XX, 8-10; anal IX-XI, 8-11; pectoral 14-16; ventral I, 5; lateral line 26-30 (32, auctt.); scales in transverse series $\begin{smallmatrix} 3-4 \\ 8-11 \end{smallmatrix}$.

Depth 2.25 to 3.2 in length; head 2.7 to 3.3 in length; eye 4 to 6 in head, equal to or a little more than snout.

The form is variable, as age and amount of food cause much alteration in bodily appearance and proportions, but it is always

more or less compressed, with a broad to very broad subcylindrical head. In a specimen 28 millimeters long the head is 2.5 in the length, and in one 18 millimeters long it is 2.25 times in the length. The dorsal and ventral profiles are very much alike, moderately or slightly convex, the interorbital space broad to very broad, often flat; head scaled, with four or five rows of scales between eye and rear margin of preoperculum; operculum, suboperculum, interoperculum, and preorbital margined by long stout divergent spines, less well defined in the young, and few or absent in very young specimens; preoperculum with a few spines on lower posterior border; jaws equal or sometimes lower one slightly prominent; jaws with narrow bands of small crowded teeth and a wedge-shaped row of slightly larger teeth on vomer; anterior nostril with a tube, none on the larger posterior nostril; origin of dorsal over hind margin of opercle or over the short pectoral; dorsal and anal spines strong, sharp, shorter than the rays; first dorsal spine shortest, third or fourth and three or four immediately following longest; origin of ventrals behind that of pectorals; caudal rounded; lateral line interrupted below hinder part of spinous dorsal, and continued on second scale row beneath back to caudal.

Color in life dark to pale greenish, belly and throat very pale, back dusky to dark olive, with a transverse band of warm reddish brown on top of head; longitudinal stripes of alternate silvery and dark greenish on jaws, chin, and throat; a triangular dark spot on posterior margin of opercle and a row of small dark spots passing over head to opposite side; a similar but smaller row passing forward and crossing over head behind eyes; posterior half of body with rather vague vertical crossbands; a large circular spot at base of caudal; dorsal spines dark, the rays pale, as are all the other fins; dark spot at base of each dorsal spine; iris golden reddish.

In the interior of Cotabato Province, especially in Lake Buluan and the rivers between it and the town of Cotabato, there occur many albino climbing perch, varying from brass color to pure golden and orange; occasionally one sees particolored specimens, with spots of dark greenish here and there amid the general brassy yellow. No other author seems to have noted this condition except Francis Day, who obtained a single orange-colored specimen in the Ganjam District, India. In 1921 Governor Unson, of Cotabato, sent me two living albinos. One was injured en route and lived but a month; the other is still alive in

the Bureau of Science Aquarium. Mr. Vallodolid, instructor in zoölogy at the College of Agriculture at Los Baños, has a living albino 230 millimeters long, which was brought to him by a student who obtained it from Lake Buhi, Camarines Sur Province.

Color in alcohol greenish or greenish olive to dark brown, uniform or paler below; a large dark spot usually present at base of caudal and a small one at posterior margin of opercle; posterior half of body often with faint transverse markings; fins brownish or dark. Albino specimens in alcohol become much paler than they were in life.

This remarkable fish occurs in slow streams, ditches, ponds, and lakes throughout the Islands, but does not occur in the mountains and, unlike dalag, has not been planted in elevated lakes. I have examined many specimens, ranging in length from 18 to 156 millimeters. My largest specimen is 190 millimeters long over all, but the species reaches a total length of 230 millimeters. The statement quoted by Smith (l. c.) that it attains a weight of two pounds in Lake Buhi is not borne out by the facts, specimens of 230 millimeters in length being very rare there.

The climbing perch is highly variable, and there can be no doubt that but one species is recognizable. The usual number of dorsal spines is from seventeen to nineteen, but sixteen is not rare, while one of my albino specimens has twenty. Weber and Beaufort give the number of transverse scales below the lateral line as seven to ten.

The thin delicate plates composing the labyrinth in the cavity above the gills vary much in their development, according to the age of the animal. In very small specimens there are but two of the thin, bony, straight-edged plates, but with advancing age more are added, so that in large specimens there may be half a dozen concentrically arranged laminae with undulated and curtainlike edges.

Ever since 1791, when Daldorff captured a climbing perch in the act of ascending the trunk of a palmyra growing near a pond, this fish has been celebrated for its ability to live out of the water and to move about freely upon the land.

The animal seems to have two distinct modes of locomotion when out of the water. In one method, which closely resembles that used by many other fishes, the body is held up by the pectorals, the opercles are extended at nearly right angles to the

body, and by means of the caudal the fish leaps or glides along rapidly. In the other method the body is inclined to one side, so that the sharp spines of the subopercle come in contact with the surface; the closing of the opercle then pulls the body forward, its progress being assisted by the movements of the caudal, the anal, and the pectorals. In this manner it is able to make its way over long distances and to surmount very considerable obstructions, or even to ascend for a meter or two the rough trunk of certain palms.

During the dry season the climbing perch is able to survive in very small pools of semiliquid mud. Since it takes the hook greedily, it is common in the dry season to see someone fishing in what seems to be a dry field of waving grass. Out of a small puddle in such a place may be caught one or two dozen fish. In spite of their small size and many bones they are much prized as food, especially in the interior along the great rivers and in swampy regions, and large quantities may be seen alive at nearly all times in the Manila markets. It is claimed that this fish is able to survive as long as six days out of water.

As already indicated, their present range is no indication of their natural distribution, since Hindu and Malay migratory boatmen have the habit of carrying them alive with them. In this manner they have been distributed far to the eastward of their native habitat, as was pointed out by Regan in 1909.

Order NEMATOGNATHI

CATFISHES

The catfishes are recognized at once by their naked body covered with thick, slimy skin, or with bony plates on the head in some of the Philippine species, but never with scales, and by their long feelers, or barbels, borne by the rudimentary maxillaries.

As only the exclusively fresh-water families of catfishes are here presented, a full diagnosis is deferred until a revision of all the Philippine members of the order shall have been completed.

Key to the families here described.

- α¹. Dorsal spineless, with many rays; anal very long; four pairs of barbels present; top of head with bony plates..... Clariidæ.
- α². Dorsal spineless, very short, rudimentary, or absent; anal very long; two or three pairs of barbels; no bony plates on head..... Siluridæ.

CLARIIDÆ

The body is long and eel-like, with a much flattened head, the top and sides of which are covered with plates of bone; below these is a cavity, an offshoot of the gill chamber, which contains dendritic accessory breathing organs that are attached to the second and fourth gill arches; in the bony roof of the brain cavity are two fontanels, or openings, an occipital and a frontal one, covered only by skin. There are four pairs of barbels, nasal, maxillary, and two on the mandible; the anterior nostrils are in short tubes behind the upper lip, and the posterior ones are more or less rounded slits behind the nasal barbels; the eyes are small and have a free margin; the dorsal and anal are both very long, extending to or united with the caudal, of soft rays only, or the dorsal may be short and followed by an adipose fin; only the pectoral has a sharp spine; ventrals with six rays; jaws with more or less united patches of very fine teeth, a crescentic band of similar teeth on the vomer; skeleton soft, cartilaginous.

Fishes of muddy streams, ponds, swamps, and rice paddies in the East Indies, Formosa, Africa, and the intervening parts of Asia; the Philippine species are all small, though some members of the family are very large, reaching a length of nearly 2 meters.

Genus *CLARIAS* (Gronow) Scopoli

Clarias GRONOW, Zoophyl. (1763) 100; Scopoli, Introd. Hist. Nat. (1777) 455.

Dorsal very long, its origin at nape, extending nearly or quite to caudal, with which it may be united; gill slits very wide, gill membranes free from isthmus; gill rakers seventeen to nineteen; branchiostegals seven to nine, air bladder small, transverse, lobed, encased in bone. In other respects the characters are those of the family. The number of bony plates on the top and sides of the head is variable, even in the same species. Young specimens have fewer plates, additional sutures appearing with age, so that large old fishes may have many more plates than young ones.

Key to the Philippine species of Clarias.

- α^1 . Dorsal and anal free from caudal; head with fifteen to seventeen bony plates *C. batrachus*.
 α^2 . Dorsal and anal united to caudal, at least at its base; head with twenty-one bony plates..... *C. gilli*.

Clarias batrachus (Linnæus).

Silurus batrachus LINNÆUS, Syst. Nat. ed. 10 1 (1758) 305.

Clarias batrachus BLEEKER, Atlas Ichth. 2 (1862) 103, pl. 98, fig. 2; PETERS, Monatsber. Akad. Wiss. Berlin (1868) 271; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 2 (1913) 190, fig. 74.

Clarias magur GÜNTHER, Cat. Fishes Brit. Mus. 5 (1864) 17; JORDAN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 8.

Catfish. *Hito* in Tagalog; *paltat*, *pantat*, and *pa'tat* in Ilocano and other languages of northern Luzon.

Dorsal 60-76; anal 47-58.

Body elongate, with strongly sloping depressed head, very low anteriorly, and rather short, rounded caudal which is free from both dorsal and anal; depth 5 to 5.8, head to gill opening 4.4 to 4.7 in length; eyes small, with free orbital margin, 9 to 14 in head; dorsal profile an almost straight line from tip of snout to posterior end of head; top of head gently convex transversely and composed of fifteen bony plates, this number increasing to seventeen or more (twenty-three?) in old specimens; the large central frontal plate with a fontanel, or opening, extending at least as far forward as middle of eyes (in one specimen wholly behind eyes), and more than twice as long as fontanel of the large occipital plate; all plates more or less granular beneath their covering; teeth very small, those of maxillaries smallest, in a rather wide band, those on vomer in a broader, crescent-shaped band; teeth on mandibles in two somewhat quadrangular bands with the outer posterior angle produced laterally, separated by a narrow but well-defined groove; barbels long, the nasal extending almost or quite to occipital fontanel, the other barbels extending upon or to middle of pectorals, the maxillary pair sometimes still longer; pectoral spine stout, sharp, smooth or sometimes a little roughened, covered with skin except near its tip, about three-fourths as long as pectoral fin; height of dorsal $\frac{1}{3}$ to 0.4 length of head.

Color in life dark, more or less bluish black, belly and throat pale or whitish; usually with vertical rows of white spots along sides from dorsal to lateral line and a longitudinal row or partly double row of similar spots beginning behind pectoral and running low down on side to caudal peduncle.

Color in alcohol similar, or becoming uniform brown.

I have examined many specimens, from 45 to 235 millimeters long, from the following localities: Tuao and Aparri, Cagayan; Vigan and Santa Maria, Ilocos Sur; Pampanga and Bulacan Provinces; Manila; Cavite, Cavite; and Jaro, Leyte. My largest specimen measures 270 millimeters over all.

Large numbers of this species are brought alive to the Manila market, where they can be seen at nearly all times of year; Tarlac and Pampanga furnish the chief supply. Though I have seen specimens from Luzon and Leyte only, the species has been recorded from Catbalogan, Samar, by Peters, and it doubtless occurs in other islands. Two kinds of catfish are said by the Maguindanao Moros to live in the ponds and swamps of the Pulangi, Cotabato Province, and it may be that *C. batrachus* is the second species, as *C. gilli* is the only one in collections from that region.

This fish lives in swamps, ponds, ditches, rice paddies, and the pools left in low spots after rivers have been in flood. Though far from a handsome fish its flesh is good and is much esteemed by the people of the western part of central and northern Luzon. When very small it is called *pantat* by the Tagalogs, a name applied to the adults by some of the people of northern Luzon, while very large adults are called *hitong batukan*.

Occasionally albino specimens occur in the swamps of Bulacan, Pampanga, and Tarlac, and for several years living albinos have been kept in the Bureau of Science Aquarium. They vary in color from yellow to whitish yellow, either with or without irregular dark blotches of the ordinary color.

This species is said to reach a length of over 400 millimeters, and occurs from the Philippines through Borneo to Sumatra and throughout the Malay Peninsula to Ceylon and Hindustan.

Clarias gilli Smith and Seale.

Clarias gilli SMITH and SEALE, Proc. Biol. Soc. Washington 19 (1906) 74, text figure.

? *Clarias nieuhoi* GÜNTHER, Cat. Fishes Brit. Mus. 5 (1864) 20, p. p.; PETERS, Monatsber. Akad. Wiss. Berlin (1868) 271.

Balika or *balik* in Maguindanao Moro.

Dorsal 88-94; anal 71-87; ventral 5.

Depth 8.3 to 9.8, head 6.6 to 6.7, tip of snout to posterior margin of occipital process 5.4 to 5.6 in length; distance from dorsal to occipital process 2 to 2.4 in distance from occipital process to tip of snout; eye very small, 16 to more than 17 in head, with a free orbital margin; dorsal thick, low, its height 3.5 to 4 in head and equal to or nearly equal to the small short ventrals, which are 3.4 to 3.7 in head; dorsal and anal confluent with caudal.

Body very elongate and eel-like, apparently with a distinct neck, the depth of posterior part of head more than that of body between head and beginning of dorsal; trunk very short, less than a fourth of total; tail deeper than trunk, 0.61 to 0.62 of length; head much depressed anteriorly; upper profile nearly straight from snout to posterior extremity of head and nearly flat in the middle, gently convex from side to side; top of head with twenty-one bony plates, the frontal fontanel far behind eyes and larger than the occipital one; barbels long, maxillary reaching nearly or quite to tip of pectoral, which is very short, its sharp spine smooth or granular and covered with thick skin; teeth all small, villiform, those of maxillaries in a quadrangular curved band; teeth on vomer somewhat larger, in a broad, somewhat crescent-shaped band, middle of posterior border with a prominent extension; teeth on mandibles still coarser forming a broad angular band with the outer posterior corners much extended backward and a narrow groove extending from behind forward along median line, nearly or quite dividing it in two.

Color in life bluish black, belly and throat paler to whitish; in alcohol turning brown to yellowish brown.

Here described from two specimens, respectively 335 and 345 millimeters long, collected by me in the market at Tituan, a barrio on the Rio Grande de Mindanao, Cotabato Province. In addition to other specimens obtained there, I also collected this species in Malupali River at Mailag, Bukidnon, and in a brook near Santa Fe, Bukidnon, the last at an approximate elevation of 615 meters. My largest specimen is 378 millimeters over all, my smallest 113 millimeters, or 130 millimeters including the caudal. Small specimens are not so slender and have the eye larger in proportion.

I also refer here provisionally four medium-sized to large specimens collected by Alejo Arce at Lake Batu, Camarines Sur Province, and a large specimen of unknown origin. In some of these the frontal fontanel is partially divided by a bony ridge so that it is superficially, at least, almost two. Smith and Seale give a figure showing *C. nieuhoi* with but eight bony plates on the top and sides of the head, and with two fontanels in the frontal plate, thus agreeing with Bleeker's figure of that species. If this is correct, the Philippine specimens referred by Günther and Peters to *C. nieuhoi* are probably *C. gilli*. Only an examination of the type of *C. nieuhoi* will decide the validity of *C. gilli* as a distinct species.

Clarias gilli is common over Mindanao and seems to occur also in southeastern Luzon; no other locality is known.

SILURIDÆ

Elongate fresh-water catfishes with more or less strongly compressed bodies, the head conical or with a depressed snout, and without bony plates or scutes; only two pairs of barbels are ordinarily present, a maxillary and a mandibular, but there may be an additional pair behind the chin; the dorsal is short or may be either rudimentary or altogether wanting; there is neither dorsal spine nor adipose fin; a spine is always present on the pectoral; the small ventrals are below or behind the dorsal or may be rudimentary or absent; the anal is long, with many rays, and extends nearly to the caudal or is more or less completely united with it; the caudal is deeply and obliquely forked, emarginate, or rounded; the teeth are villiform, except in one genus in which they are widely set and long, in bands on the jaws, in one or two patches on the vomer, and absent on the palatines except in the two new genera here included; branchiostegals nine to twenty; the gill membranes are more or less overlapping, free from each other and from the isthmus.

Key to the Philippine genera of Siluridæ.

- a¹. With one pair of barbels under chin..... Hito.
a². With two pairs of barbels under chin..... Penesilurus.

Genus HITO novum

Body narrow, strongly compressed, with broad, stout head and moderately depressed snout, dorsal profile convex to nearly straight; mouth wide, nearly horizontal, with subequal jaws or the lower slightly projecting; teeth minute, villiform, depressible, in bands on jaws, usually divided by a narrow median groove, a single narrow transverse band on vomer, and a small patch on each palatine; anterior nostrils tubulate, posterior with an incomplete elevated margin which becomes a flap on anterior side; eyes covered by skin, behind angle of mouth; a pair of maxillary and a pair of mandibular barbels, the latter some distance behind point of chin; between them a fold of skin which forms a wide rounded crypt under chin; dorsal fin with four rays, its base very short; pectorals with a spine; ventrals small, below dorsal; anal very long, not united to caudal; branchiostegals twelve to fourteen; gill rakers fourteen; gill membranes free from each other and from isthmus.

Close to *Silurodes* Bleeker, but with teeth on the palatines and a different number of branchiostegals.

Type of the genus, *H. taytayensis* sp. nov.

Hito, a Filipino name for certain catfishes.

Hito taytayensis sp. nov.

Dorsal 4 or 3; anal 57-61; pectoral I, 11; ventral 7; branchiostegals 12 to 14; gill rakers 14.

Depth 5 to 5.5, head equal to trunk and 4.9 to 5 in length; eyes 6.2 to 7.2 in head, about 3 in the broad, blunt, somewhat rounded snout, and about 4 in the convex interorbital space; eyes opposite, or lower margin opposite angle of mouth, from which they are a diameter distant; anterior and posterior nostril on each side an eye diameter apart; jaws equal or the lower one slightly projecting; bands of teeth on jaws widest posteriorly, narrow and with or without a median groove at symphysis; teeth on vomer larger, in two to four rows; patches on palatines elongate or oval, or sometimes reduced to mere asperities on one side at least; barbels short, maxillary 3.7 to 4 times in length, those on mandible much shorter than head, 7 to 9 or even 13 times in length; dorsal fin very small; pectorals short, not extending as far back as to ventral, 6.6 to 7.5 in length, pectoral spine about two-thirds as long as fin, stout, sharp-pointed, smooth on anterior but serrate on posterior surface; the very small ventrals behind dorsal do not extend upon anal, only reaching its base; anal very long, wide, prominent, free from base of forked caudal which is as long as head.

Color in alcohol uniform yellowish brown, everywhere sprinkled with minute dark brown specks; a large dark blotch on side between lateral line and pectoral; fins all colorless.

Here described from the type, No. 9357 Bureau of Science collection, and seventeen cotypes, collected from a small fresh-water creek near Taytay, Palawan, in May, 1913. The type and largest specimen is 100 millimeters long or 120 millimeters including caudal; the smallest of the lot is 58 millimeters in length.

Genus **PENESILURUS** novum

Body elongate, strongly compressed, with broad, rounded head, dorsal profile nearly straight; dorsal fin vestigial, of two partly united filaments, before the small ventral of six rays; no adipose fin; mouth terminal, large, lower jaw slightly projecting; eyes subcutaneous, situated behind corner of mouth;

anterior nostrils slightly tubulate; posterior nostrils with a small anterior marginal flap; pectorals with a spine; anal long, wide, ending at base of caudal; one pair of long maxillary barbels and two pairs of mandibulatory barbels far behind symphysis, the anterior pair nearer median line; teeth villiform, in bands on jaws, in a single straight band on vomer; a small patch on palatines; ten branchiostegals; fifteen gill rakers, the gill membranes free from the isthmus.

Pene, almost; *Silurus*, a genus of catfishes, from the classical name of the European sheatfish.

Type of the genus, *P. palavanensis* sp. nov.

This genus is distinguished from the closely related *Hito* by the extra pair of mandibulatory barbels.

Penesilurus palavanensis sp. nov.

Dorsal 2; anal 55; pectoral I, 11; ventral 6.

Depth 5.14, the broad, low head as long as trunk and 4.7 in length of the compressed body; tail more than 0.57 of length; head nearly flat, gently rounded from side to side, with a wide, broadly rounded snout; eyes extend below level of corner of mouth, from which they are distant an eye diameter; eye $7\frac{3}{8}$ in head, 3 in snout, and 4 in the broad interorbital space; anterior nostrils slightly anterior to maxillary barbels, posterior nostrils an eye diameter behind anterior ones; maxillary barbel long, extending nearly to tip of pectoral, a trifle more than 3 times in length; the mandibulatory barbels about equal in length, each extending upon the pectorals, 6 or nearly 6 in length, anterior barbel an eye diameter from the posterior, more external one; a broad thick fold of skin forms a deep Δ -shaped crypt under chin, its apex between the anterior pair of barbels; teeth minute, depressible, curved, those of intermaxillaries in two bands separated by a narrow toothless groove, and broadest posteriorly; teeth on vomer somewhat larger, in a nearly straight band of two rows; a patch of teeth on left palatine but not on right, which has merely a roughened spot; teeth on mandibles in a wide uniform band; dorsal vestigial, basally coalesced, with two tiny projecting filaments; pectoral spine stout, sharp, inner surface minutely denticulate, five-ninths as long as pectorals, which are contained 6 times in length; ventrals small, badly broken in my specimen, only the bases of the six rays left; anal broad, ending just before base of caudal, of which only the stump is left.

Color in alcohol pale yellowish brown, the fins very pale.

Here described from a specimen 108 millimeters long in poor condition, caught with hook and line by Prof. A. L. Day at Lake Manguao, Palawan, in May, 1913.

SUMMARY OF PHILIPPINE TRUE FRESH-WATER FISHES

CYPRINIDÆ

ABRAMIDINÆ

Genus *NEMATABRAMIS* Boulenger

1. *verecundus* Herre; Titunod River, north coast of Mindanao.
2. *alestes* (Seale and Bean); Zamboanga, Mindanao; Puerto Princesa and Taytay, Palawan; Busuanga.
3. *everetti* Boulenger; Palawan.

RASBORINÆ

Genus *RASBORA* Bleeker

4. *taytayensis* Herre; Taytay, Palawan.
- 4a. *lateristriata* Bleeker; Malum River, Tawitawi.
5. *punctulatus* Seale and Bean; Zamboanga, Mindanao.
6. *argyrotaenia* Bleeker; Busuanga; Lake Manguao and Puerto Princesa, Palawan.
7. *philippina* Günther; Zamboanga and Cagayan de Misamis, Mindanao.

CYPRININÆ

[Genus *CYPRINUS* Linnæus]

[*carpio* Linnæus; naturalized in rivers of Cotabato Province and Lake Nunungan, Lanao Province, Mindanao.]

Genus *MANDIBULARCA* Herre

Corpus oblongum sat compressum; venter latum; rostrum brevis latum haud prominens; mandibulum spatulatum, angustum, tenuis, prominens, elongatum, resimum; labia inferiore tenuis vel nulla; cirri 4.

8. *resinus* Herre; type of the genus; Agus River, Lake Lanao, Mindanao.

Genus *HAMPALA* Bleeker

9. *lopezi* Herre; Busuanga.

Genus *CEPHALAKOMPSUS* Herre

Corpus oblongum elongatum compressum; venter rotundatum; caput et rostro magnum et incultum; labiae crassae rugosae; sulcus postlabialis unicus margini maxillae libero parallelus formam rictus referens; pinna dorsalis ante ventrales; spina dorsalis gracilis paulo denticulata; squamae magnae, $3\frac{1}{2}$ inter lineam lateralem et pinna dorsalis; plicones sensorum capitis nulli; cirri 4, robusti.

10. *pachycheilus* Herre; type of genus; Lake Lanao, Mindanao.

Genus **OSPATULUS** Herre

Corpus crassum robustum, venter rotundatum; caput inferiore latissimus; mandibulum brevis, maxillae superiores non attingente, speciam ospatulum; pinna dorsalis basi non vel paulo squamosa, ante ventrales, spina gracilis paulo denticulata; sulcus postlabialis subtus mentum interruptus; cirri 4.

11. truncatulus Herre; type of genus; Lake Lanao, Mindanao.
12. palaemophagus Herre; Lake Lanao, Mindanao.

Genus **BARBODES** Bleeker

13. hemictenus Jordan and Richardson; Mindoro.
14. ivis (Seale); Palawan; Balabac; Busuanga.
15. tumba Herre; Lanao Plateau, Mindanao.
16. quinquemaculatus (Seale and Bean); Zamboanga, Mindanao.
17. binotatus (Cuvier and Valenciennes); all of Mindanao except the Lanao Plateau.
- var. palavanensis (Boulenger); Palawan.
18. montanoi (Sauvage); Simulao River, Agusan Province, Mindanao.
19. clemensi Herre; Lake Lanao, Mindanao.
20. amara Herre; Lake Lanao, Mindanao.
21. flavifuscus Herre; Lake Lanao, Mindanao.
22. manguaoensis (Day); Lake Manguao, Palawan.
23. bantolensis (Day); Lake Manguao, Palawan.
24. lanaoensis Herre; Lake Lanao, Mindanao.
25. katolo Herre, Lake Lanao, Mindanao.
26. manalak Herre; Lake Lanao, Mindanao.
27. lindog Herre; Lake Lanao, Mindanao.
28. palata Herre; Lake Lanao, Mindanao.

Order LABYRINTHICI**OPHICEPHALIDÆ**Genus **OPHICEPHALUS** Bloch

29. melasoma Bleeker; Palawan.
30. striatus Bloch; general throughout the Philippines.

OSPHRONEMIDÆGenus **TRICHOGASTER** Bloch and Schneider

31. trichopterum (Pallas); Cagayan Sulu.

ANABANTIDÆGenus **ANABAS** Cuvier

32. testudineus (Bloch); generally distributed.

Order NEMATOGNATHI**CLARIIDÆ**Genus **CLARIAS** (Gronow) Scopoli

33. batrachus (Linnæus); Luzon and Leyte.
34. gilli Smith and Seale; Mindanao; Lake Bato and Bicol River, Luzon.

SILURIDÆ

Genus **HITO** novum

Dentes maxillis pluriseriati setacei; dentes vomerini in vittam angustam transversam continuam dispositi; dentes unusquisque palatinus in maculum parvum; nares anteriores brevi-tubulatae, posteriores valvula claudendae; pinna dorsalis supra ventres parvi; pinna analis caudali haud unita; pinna caudalis biloba; cirri 4; branchiost. 12-14; D. 4-3; A. 57-61; P. I. 11; V. 7. 35. *taytayensis* sp. nov., type of the genus; Taytay, Palawan.

Genus **PENESILURUS** novum

Dentes maxillis pluriseriati setacei; dentes vomerini in vittam angustam transversam continuam dispositi; dentes palatini in maculae parvi; nares anteriores pauci-tubulatae, posteriores valvulae parvi margini anteriores; pinna dorsalis rudimentaria, ante ventres parvi; pinna analis caudali haud unita; cirri 6, supramaxillares 2, inframaxillares 4; branchiost. 10; D. 2; A. 55; P. I. 11; V. 6.

36. *palavanensis* sp. nov.; type of the genus; Lake Manguao, Palawan.

ILLUSTRATIONS

PLATE 1

Trichogaster trichopteron (Pallas). Drawn by T. S. Espinosa from one of the type series of *Osphromenus insulatus* Seale; about $\times 2$.

PLATE 2

FIG. 1. *Anabas testudineus* (Bloch); $\times 1$. Drawn by M. Ligaya.
2. *Ophicephalus striatus* Bloch; $\times 1$. Drawn by M. Ligaya.

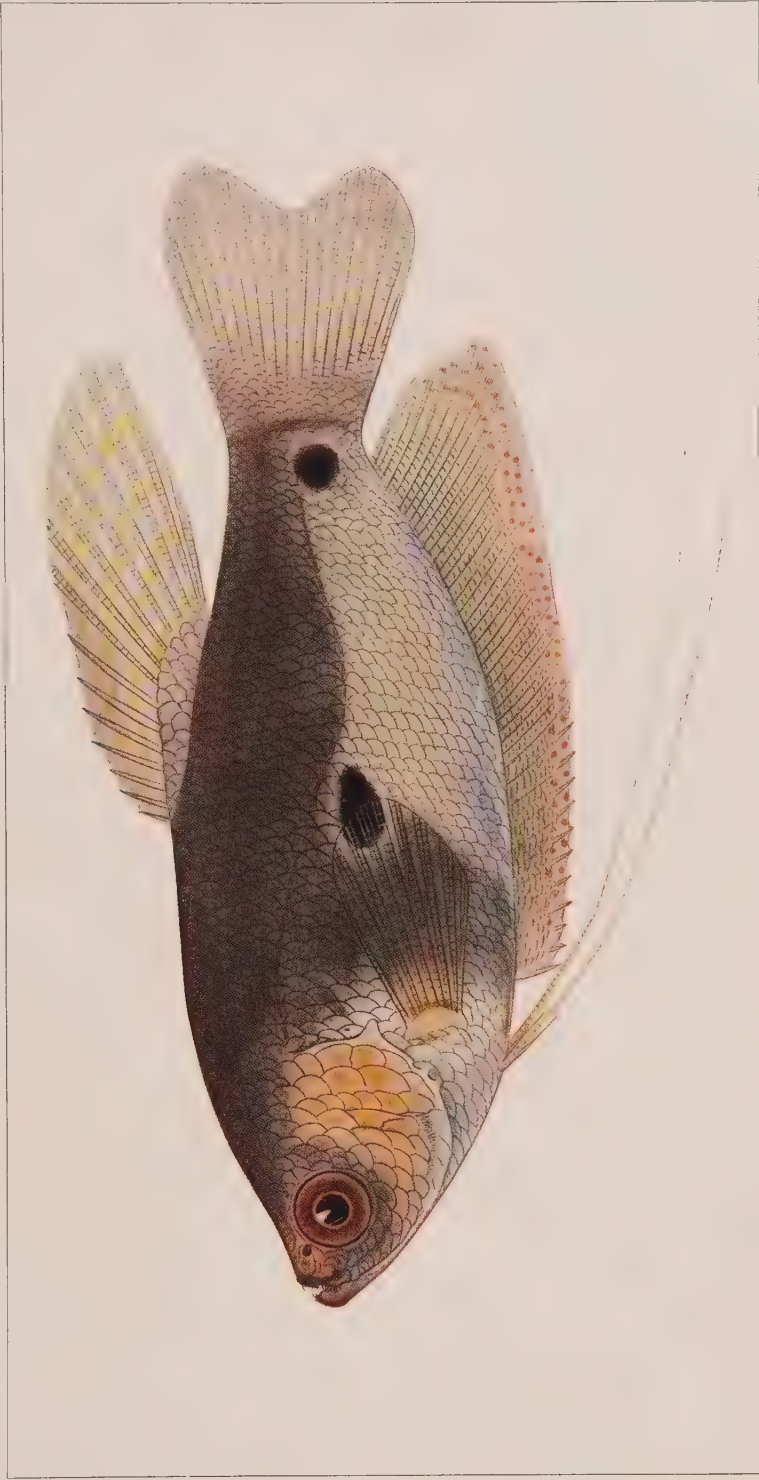


PLATE 1. TRICHOGASTER TRICHOPTERUM (PALLAS).

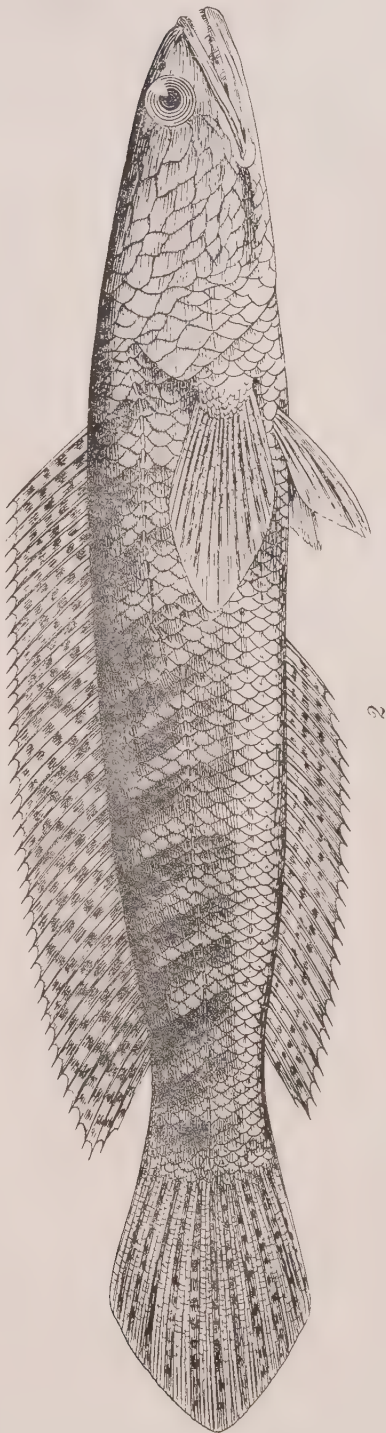
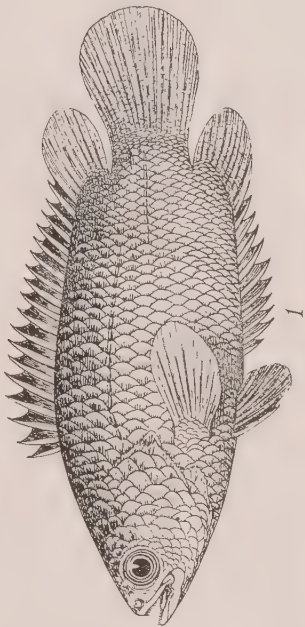


PLATE 2.

SOME APHIDIDÆ FROM THE FAR EAST

By RYOICHI TAKAHASHI

Of the Department of Agriculture, Government Research Institute, Formosa

The aphids recorded in the present paper have been received from various sources. The Sakhalin specimens were collected by Prof. T. Esaki; the Korean material, by Mr. S. Muramatsu; the Manchurian, by Mr. Y. Yamada; and the Chinese, by Prof. Chen Shi-san, of the University at Nanking and by Mr. T. Nakajima in Amoy. The Japanese species are either from material sent in by Mr. M. Kurisaki or from my own collection. Grateful acknowledgment is due the above-named collectors who have contributed specimens.

The present records of aphid species are of particular interest in that practically nothing is known about this group of insects from those localities. The aphid fauna of North China, including Mongolia and Manchuria, and that of Korea and Sakhalin are absolutely untouched. Only a few species from Siberia have been recorded by Mordwilko, and nine from South China, by Lichtenstein and by Van der Goot.

Macrosiphum rudbeckiæ (Fitch).

Aphis rudbeckiæ FITCH, Cat. Homop. N. Y. (1851) 66; ESSIG, Pomona Coll. Journ. Ent. 3 (1911) 400.

Siphonophora rudbeckiæ THOMAS, Illinois State Lab. Nat. Hist. Bull. 2 (1878) 4; OESTLUND, Geol. Nat. Hist. Survey, Minnesota (1886) 20.

Nectarophora rudbeckiæ OESTLUND, Geol. Nat. Hist. Survey, Minnesota, Bull. 4 (1887) 85.

Macrosiphum rudbeckiæ DAVIDSON, Journ. Econ. Ent. 7 (1914) 136; ESSIG and KUWANA, Proc. Calif. Acad. Sci. 8 (1918) 52; SWAIN, Univ. Calif. Pub., Technical Bull. 3 (1919) 67; PATCH, Maine Agr. Exp. Sta. Bull. 282 (1919) 218.

Host.—Unknown in Sakhalin.

Distribution.—Japan, Tokyo; Sakhalin, Toyohara; North America. Hitherto unrecorded from Sakhalin.

A winged and some wingless viviparous females were collected by Prof. T. Esaki at Toyohara, Sakhalin, in July, 1922. The specimens from Sakhalin agree in all taxonomic characters with those from Japan.

Macrosiphum rosæ (Linn.).

A few viviparous females were collected on *Rosa* sp. by Mr. T. Nakajima at Amoy, China, in June, 1923. Hitherto unrecorded from China.

Rhopalosiphum pseudobrassicæ (Davis).

Aphis pseudobrassicæ DAVIS, Canad. Ent. 46 (1914) 231.

Rhopalosiphum pseudobrassicæ TAKAHASHI, Aphididæ of Formosa, part 1 (1921) 33; part 2 (1923) 91.

Host.—*Brassica oleracea* Linn.

Distribution.—Formosa, Japan, China, India, Java, Africa, North America. Hitherto unrecorded from China.

Collected by Prof. Chen Shi-san and sent to me for identification.

Aphis rumicis Linn.

Aphis rumicis TAKAHASHI, Aphididæ of Formosa, part 1 (1921) 47; part 2 (1923) 101.

Host.—*Rumex* sp.

Distribution.—Formosa, Japan, Sakhalin, India, Africa, Europe, North America. Hitherto unrecorded from Sakhalin.

A winged and numerous wingless viviparous females were collected by Professor Esaki at Toyohara, Sakhalin, in July, 1922.

Aphis gossypii Glov.

Some viviparous females were collected by Mr. T. Nakajima on *Colocasia antiquorum* Schott at Amoy, China, in June, 1923. Hitherto unrecorded from China.

Toxoptera leonuri Takah.¹ is an abnormal form of *A. gossypii* Glov. and must therefore be considered as a synonym of the latter. Some winged viviparous females, the third obliques of which are twice forked, and wingless ones were collected on *Leonurus sibiricus* Linn., on April 8, 1923, at Tansui, Formosa.

Aphis odinæ Van der Goot.

Longiunguis odinæ VAN DER GOOT, Contrib. Faun. Ind. Neerland. 1 (1917) 113.

Aphis somei ESSIG and KUWANA, Proc. Calif. Acad. Sci. IV 8 (1918) 75; TAKAHASHI, Aphididæ of Formosa, part 1 (1921) 58; part 2 (1923) 110.

Host.—*Sapium sebiferum* Roxb.

Distribution.—Japan, Formosa, Java, China. Hitherto unrecorded from China.

¹ Aphididæ of Formosa, part 1 (1921) 41; part 2 (1923) 94.

Some viviparous females were collected by Mr. T. Nakajima on the plant mentioned above, on June 26, 1923, at Amoy, China.

? *Aphis malvoides* Van der Goot.

Aphis malvoides VAN DER GOOT, Contrib. Faun. Ind. Neerland. 1 (1917) 96; TAKAHASHI, Aphididæ of Formosa, part 2 (1923) 37 and 103.

Host.—*Bidens pilosa* Linn.

Distribution.—Formosa, China, Java, Singapore. Hitherto unrecorded from China.

Some specimens were collected by Mr. T. Nakajima at Amoy, China, in June, 1923.

Myzocallis querciformosanus Takah.

Myzocallis querciformosanus TAKAHASHI, Aphididæ of Formosa, part 1 (1921) 72; part 2 (1923) 120.

Winged viviparous female.—Length of body, about 1.5 millimeters; antennæ, about 1.9; forewings, about 2. White. Antennæ white; dusky at apices of joints. Wings hyaline, slightly clouded along veins. Cornicles and cauda white. Legs white, with dusky tarsi. Dorsal tubercles white. Body oblong, soft. Head between antennæ provided with three pairs of very long, capitate hairs, arising from small tubercles, and almost as long as antennal segments I and II together. Frontal tubercles very short. Eyes large, protruding, with ocular tubercles. Antennæ longer than body, slender; segment I larger than II, convex on ental margin, and provided with a moderately long, capitate hair, as in II; III somewhat imbricated on distal half; basal half with four or five circular, medium-sized or large sensoria which are arranged in a single row and with two or three capitate hairs, which are shorter than those on basal segments; IV with neither sensoria nor distinct hairs; approximate relative lengths of antennal segments: III, 105; IV, 70; V, 70; VI, 120 (35 + 85). Rostrum almost reaching middle coxæ. Pronotum with a pair of long, capitate hairs which are as long as, or shorter than, those on anteromesal border of mesonotum; a pair of fingerlike tubercles, which are smaller than those on abdomen, near hind margin. Mesonotum with about ten long, capitate hairs of variable lengths and generally shorter than those on front of head. Abdomen provided with a few moderately long bristles on sternites, but not on tergites; three pairs of fingerlike tubercles on subbasal tergites; anterior two pairs of tubercles subequal in diameter to and slightly shorter than posterior; capitate hairs, which are almost equal in length to

similar structures on front of head, on subapical parts of tubercles; four small blunt lateral tubercles, in front of cornicles, of which the posterior one is largest but shorter than cornicle; all tubercles provided with a few capitate hairs; another small blunt tubercle, which is provided with a pair of short hairs, anterior to cauda. Wings not wide; pterostigma with five long, somewhat knobbed hairs; stigmatic vein faint, almost obsolete; third oblique reaching apex of wing. Hind wings with two subparallel obliques; hooklets, two or three. Cornicles shorter than hind tarsi, longer than wide, expanded at base, not reticulated. Anal plate bilobed, with a few very long bristles. Cauda constricted basally, with a few very long bristles. Legs long and slender, furnished with many long capitate as well as normal hairs; tarsi with many minute spinules; hind tarsi almost as long as basal part of last antennal segment.

Host.—*Quercus dentata* Thunb., leaf.

Distribution.—Formosa; Japan. Hitherto unrecorded from Japan.

The Japanese specimens differ somewhat from the Formosan, but they seem to agree in sufficient characters to warrant their being placed in the same species. The foregoing description was based on specimens collected by me on June 6, 1923, at Oi in Gifu Prefecture, Japan.

In the original description I erroneously characterized the dorsal surface of the abdomen as being provided with many moderately long hairs and the antennæ as 0.95 millimeter in length. These mistakes are corrected here.

Shivaphis celti Das.

Shivaphis celti DAS, Memoirs Indian Mus. 6 (1918) 246; TAKAHASHI, Aphididæ of Formosa, part 1 (1921) 74; part 2 (1923) 131.

Host.—*Celtis* spp.

Distribution.—Formosa, China, India, Ceylon. Hitherto unrecorded from China.

Collected by Mr. T. Nakajima at Amoy, China, in June, 1923.

Chaitophorus salijaponica Essig and Kuwana.

Chaitophorus salijaponica ESSIG and KUWANA, Proc. Calif. Acad. Sci. IV 8 (1918) 84.

Host.—*Salix multinervis* Doell.

Distribution.—Japan, Sakhalin. Hitherto unrecorded from Sakhalin.

Mr. Esaki collected a winged and three wingless viviparous females from an unidentified plant at Toyohara, Sakhalin, in

July, 1922. This species is allied to *Chaitophorus populi* Linn. and *C. viminalis* Monell, especially with respect to the granular dorsal surface of the wingless viviparous female.

Genus **KURISAKIA** novum

Winged viviparous female.—Body provided with numerous fine, long hairs. Head without frontal tubercles. Eyes with ocular tubercles. Antennæ five-segmented, with many minute spinules and fine, long hairs; sensoria subcircular or oval, spur of segment V much shorter than base. Dorsal tubercles absent. Front wings with third oblique only once forked; hind wings with only one oblique. Cornicles very short, wider than long. Cauda short, wider than long, not constricted at base, rounded. Anal plate rounded. Legs normal.

Genotype, *Kurisakia juglandicola* sp. nov.

This genus differs from other genera of the tribe Callipterina in the five-jointed antennæ, as well as in the character of wing veins.

Kurisakia juglandicola sp. nov.

Winged viviparous female.—Length of body, about 2 millimeters; antennæ, about .0.95; forewings, about 2.75. Body oblong, furnished with many fine, long hairs. Head with a median line. Frontal tubercles absent. Eyes moderate in size, with distinct ocular tubercles. Antennæ not imbricated, provided with numerous minute spinules and some fine, long hairs, five-segmented; segment I almost as long as II; III provided with about fourteen oval or subcircular sensoria of medium or rather large size, arranged in a single row almost the entire length, with many fine, long hairs; IV with about ten fine, long hairs, sensorium on apex of medium or rather small size, somewhat protruding, like the sensoria on III, not surrounded by hairs; relative lengths of segments: III, 97; IV, 32; V, 44 (36 + 8). Rostrum almost reaching middle coxæ. Body without lateral and dorsal tubercles. Subcosta of forewing provided with a few fine hairs arranged sublinearly; first and second obliques slightly curved, stouter than other veins; third, only once forked, obsolete at base; pterostigma normal; stigmatic vein not obsolete, nearly reaching apex of wing. Hind wings with only one oblique; hooklets, five. Cornicles large, but very short, wider than long, expanded basally, not constricted and not reticulated, with a few long hairs. Cauda wider than long,

not constricted, rounded, hairy. Anal plate rounded. Legs provided with numerous minute spinules and many fine, long hairs; front tibiæ slightly stouter than antennal segment III; hind tarsi almost as long as base of terminal antennal segment.

Host.—*Juglans sieboldiana* Maxim.

Distribution.—Japan, Tadono, Wakayama Prefecture.

A few winged viviparous females and their nymphs were collected by Mr. M. Kurisaki on May 6, 1920. The collector furnished the following data: This aphid is found on the nether surface of the leaves. The wings are carried horizontally when at rest. The general color of the adults is yellowish green.

Dilachnus quercihabitans sp. nov.

Winged viviparous female.—Length of body, about 6 millimeters; antennæ, about 2.5; forewings, about 11; width, about 3.5. Head and pronotum blackish brown. Antennæ, eyes, and mesothorax almost black. Abdomen pale brown, with some very small and numerous minute dark brown spots on dorsum; lateral margins of last abdominal tergite and sternite dark brown. Cornicles dark brown. Cauda brown, more darkly so on posterior margin. Wings hyaline; pterostigma and subcosta dark brown; obliques yellowish brown. Legs mostly black, brownish basally. (Color notes based on specimens preserved in alcohol.) Body elongate, provided with many fine, long hairs. Head divided. Eyes prominent, with very small ocular tubercles. Antennæ relatively slender, provided with numerous very long hairs; segment I almost as long as hairs on front of head; III provided with about twelve to fourteen large, circular, protuberant sensoria, arranged in a row over entire length, except at basal fourth or fifth; IV with four to six similar sensoria mostly on distal half; V with three or four similar sensoria on distal half; VI with six to eight very small sensoria in a group near sensorium; approximate relative lengths of segments: III, 59; IV, 28; V, 30; VI, 20. Rostrum slender, reaching far beyond hind coxæ. Wings long, very delicate; pterostigma long, not reaching apex of wing; first oblique straight; second, slightly curved; third, faint, twice forked; stigmatic vein scarcely curved, reaching apex of wing. Hind wings with two divergent obliques; hooklets, six. Cornicles very short, on hairy cones. Cauda short, broadly rounded, almost semicircular from dorsal aspect; provided with numerous very long hairs. Legs very long and slender, covered with numerous very long fine hairs; tarsi long; hind tarsi longer than fifth antennal segment, first

tarsal segment almost as long as claw, second almost three times as long as first.

Host.—*Quercus serrata* Thunb.

Distribution.—Korea.

Many winged viviparous females and their nymphs were collected by Mr. S. Muramatsu at Suigen, Korea, in May, 1920.

Cotypes in my collection.

? *Tetraneura fusiformis* Matsumara.

? *Tetraneura fusiformis* MATSUMARA, Essays for Nawa (1917) 74.

Host.—*Ulmus* sp.

Distribution.—Japan, Sapporo, Oita Prefecture; Manchuria, Koshurei. Hitherto unrecorded from Manchuria.

Many winged viviparous females, probably sexuparæ, were collected by Mr. Y. Yamada at Koshurei on October 2, 1918. These specimens exactly agree in taxonomic characters with those from Japan.

The present species differs from *Tetraneura ulmi* De Geer in the following points:

Approximate relative lengths of antennal segments: III, 66; IV, 20; V, 53; VI, 15.

Approximate distribution of antennal sensoria: III, 14 to 17; IV, 3 to 4; V, 12 to 14; VI, 1.

Tetraneura yezoensis Matsumara is undoubtedly a synonym of *T. ulmi* De Geer.

Aleurodaphis blumæ Van der Goot.

Aleurodaphis blumæ VAN DER GOOT, Contrib. Faun. Ind. Neerland. 1 (1918) 240; TAKAHASHI, Aphididæ of Formosa, part 1 (1921) 92; part 2 (1923) 150.

Astegopteryx japonica TAKAHASHI, Aphididæ of Formosa, part 2 (1923) 67 and 150.

Host.—*Blumea* sp.?

Distribution.—Japan, Tokyo; Formosa, Taihoku; Java.

Some wingless viviparous females were collected by me at Ikegami, Tokyo, on June 14, 1923. These specimens exactly agree in taxonomic characters with those from Formosa. The winged form of this species was erroneously described as *Astegopteryx japonica* sp. nov. by Takahashi.² The latter name is, therefore, a synonym of *A. blumæ* Van der Goot. The winged individuals of the genus *Aleurodaphis* do not differ from those of the genus *Astegopteryx* in taxonomically important characters. In Formosa no winged form has been found.

² Aphididæ of Formosa, part 2 (1923) 67 and 150.

DRY ROT OF CITRUS FRUITS CAUSED BY A NEMATOSPORA SPECIES

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TWO PLATES AND ONE TEXT FIGURE

INTRODUCTION

There occurs in China, Japan, and the Philippines a peculiar condition of citrus fruits which considerably injures their texture, juiciness, and flavor. Philippine growers have frequently called this trouble to my attention and have experienced considerable losses on sales of such fruit. The disease has also been noted from Barbados in the West Indies by Nowell.⁽⁴⁾ Work has been undertaken on this disease in the Philippines; not as a main project but as a problem to turn to whenever directly authorized projects would permit. Although time has not permitted an exhaustive study, this paper presents a description of the disease, some work indicating its cause, a description of the interesting causal fungus, and a possible method of prevention. By pointing out the seriousness of the disease in the eastern countries, it is also hoped to forewarn American citrus growers and research men so that its entrance into the United States can be prevented by enforcement of quarantine and inspection regulations.

DESCRIPTION OF THE DISEASE

The disease affects only the fruits and is not known to affect in any way other parts of the tree. The fruits show no symptoms of the disease externally; color develops normally; the affected fruits are neither harder nor softer than normal fruits. A normal citrus fruit contains from five to about fourteen section walls which are really a development from the outer skin; from these section walls and the outer skin arise the vesicles, which are of the nature of plant hairs although very much specialized, and these are usually turgid with juice. The vascular system coming through the stem of the fruit passes through the skin and section walls to feed the vesicles. Cutting into

a fruit from the Philippines or from China or Japan, an abnormal condition is often evidenced by the thickness of the section walls, as shown in Plate 2. The section walls appear of a mealy texture, white, and as if dividing* into separate membranes. Sometimes, however, the early stages of the disease will be evidenced by the condition of the flesh which has the appearance of being dry and brittle. The individual vesicles in such cases separate easily from each other and, according to the advance of the disease, are more or less dry and free of juice. As the drying advances the vesicles become wrinkled, atrophied, and entirely separated from each other, as shown in Plate 1. A section of such a brittle, dried vesicle shows the walls to have become considerably thicker than the wall of a normal vesicle. In advanced stages of the disease the vesicles have an even greater degree of inspissation and are entirely devoid of juice.

The fruits in the early stages have an unpleasant sourish taste, but in advanced cases become dry and almost entirely tasteless. The brittle manner with which the flesh crunches when chewed suggests very much the brittleness of a cabbage.

The disease sometimes is found to be confined entirely to one or two sections of the fruit, the remaining sections being entirely normal, as shown in some of the fruits illustrated in Plate 2. Just as frequently, however, the whole fruit exhibits this drying up condition. In very bad cases the normal semblance of the flesh is entirely lost and the section or the whole fruit becomes a mass of almost dried stringy vesicles sometimes of a deeper orange color than the normal flesh. There is never any blackening, and in but few cases does putrefaction follow. The name dry rot has been used in connection with this disease and, although there are grounds for criticism of such a name, after careful consideration it has seemed the most appropriate for popular use.

ECONOMIC SERIOUSNESS OF THE DISEASE AND ITS DISTRIBUTION

The initial loss caused by this disease is to the consumer, who buys the fruit as a good orange judged by its external appearance but upon eating finds it dry and tasteless and devoid of juice. The loss will sooner or later, however, ultimately be felt by the retailer, the wholesaler and, finally, the grower. In the Philippines the growers, having produced a crop of fruits more or less affected by the disease one year, find it hard to

dispose of their crop the following year. The effect would probably be the same in other countries should the disease become established there.

Dry rot is very common in Batangas Province, which is the chief orange-producing section of the Philippine Islands. It has also, however, been reported from many other sections and is probably universally distributed in the Philippines. In China the disease has been seen commonly in the Canton delta, in the Swatow delta, at Amoy, and at Foochow. Affected fruits have been seen in Japan, but there is not enough evidence to enable one to know just how serious the disease is in that country. Foochow is well toward the northern limits of citrus fruit growing in China and there is little probability, therefore, that the temperature of either California or Florida would be a limiting factor in this disease. The disease was not seen in Java although the observations were limited.

The disease in the Philippines is very serious one year and will be scarcely noticeable for several successive years. Apparently seasonal conditions have an important influence on its occurrence. Peglion(6) notes the same variation in the occurrence of the *Nematospora* disease of hazelnuts.

HOSTS AFFECTED

Dry rot has been found upon fruits of the sweet orange (*Citrus sinensis*), the mandarin orange (*C. nobilis*), the calamondin (*C. mitis*), and the sour orange (*C. aurantium*). It has not been observed upon fruits of the grapefruit or pummelo (*C. maxima*), the lemon (*C. limonia*), the lime (*C. aurantifolia*), or the cabuyao (*C. hystrix*). In the case of the last-named three species the lack of a positive observation does not necessarily mean that they are nonsusceptible, since these species are not commercially grown to any extent in oriental countries and so opportunities for observation have been few. In the case of the pummelo (*C. maxima*) apparently there is some slight resistance to the disease; many of these fruits are produced in eastern countries, but I have never observed dry rot upon that host.

CAUSE OF THE DISEASE

Examination of vesicles from diseased tissue reveals almost uniformly yeast cells, and in many cases long slender spores. Isolation plantings have been made from bits of the

diseased tissue, upon nutrient media in Petri dishes; such isolations have yielded a growth of the yeast with the nemalike spores in more than 95 per cent of the isolation attempts. Over two hundred such isolation attempts have been made. The growth from the early stages of the disease is usually a pure culture.

Inoculation studies, when undertaken in Philippine orchards, were at first almost entirely unsuccessful, due mainly to the rapid infection of the ripe citrus fruits with secondary fungi under the tropical conditions when needle punctures were made. Therefore, an attempt was made to coat the whole fruits with an infusion of the yeast cells, trusting to chance insect punctures to bring about infection. Another possibility that infection might take place at the stem end of the fruits also seemed plausible. Table 1 shows the first series of inoculations which had any significance.

The yeast cells with the nemalike spores were reisolated from inoculated fruits, both under the microscope and in culture. The conclusions from these inoculation tests are fairly well expressed in the following extracts from the field notebook:

The most noticeable evidence from these inoculation experiments is that all the young green fruits remained negative, controlled fruits and inoculated fruits alike. Apparently then only the large, more nearly mature fruits are susceptible.

A year later, on my return to the Philippines, inoculations were made with cultures of the yeast reisolated from the positive results of the earlier inoculation series. The results of these tests are summarized in Table 2. Such inoculated fruits, whether in the orchard or in moist chambers, were first immersed in alcohol and dried, and inoculations by puncture were made always with a flamed needle.

To summarize the results shown in Table 2, 50 fruits punctured with a sterile needle and sterile water showed 8 positive cases of dry rot, or 16 per cent. The results from 82 fruits inoculated with a sterile needle and pure culture of the dry rot organism gave 48 positive cases, or 51 per cent. The following extracts from the field notebook give the conclusions drawn from the results at the time:

The experimental results to support the view that the causal organism is the yeast are not the clear-cut data which are desirable. The difficulty lies in the fact that susceptible mature fruits in nature show such a high percentage of disease cases and that secondary rots cloud the results of inoculations by puncture. The evidence then must lie in obtaining a higher percentage of disease cases in the inoculated fruits than in the controls and this result has been obtained repeatedly as the data show.

TABLE 1.—Summary of results of inoculations with yeast infusion on citrus fruits of different ages under orchard conditions.

Character of fruits inoculated.	Inoculum of distilled water.		Inoculum of infusion of yeast cells.		Date of—	
	Fruits inoculated.	Positive infections.	Fruits inoculated.	Positive infections.	Inoculation.	Examination.
		<i>Per cent.</i>		<i>Per cent.</i>		
Calamondin fruits, all degrees of maturity; no punctures-----	10	10	10	40	October 24, 1918-----	November 26, 1918.
Small green calamondin fruits; no punctures-----	10	0	10	0	December 4, 1918-----	December 31, 1918.
Large green calamondin fruits; no punctures-----	10	10	10	40	do-----	Do.
Large ripe calamondin fruits; no punctures-----	20	35	10	90	do-----	Do.

TABLE 2.—Results of inoculations with yeast organism on citrus fruits under orchard and laboratory conditions.^a

Character of fruits inoculated.	Method of inoculation.	Fruits inoculated.	Positive results.	Date of inoculation.	Date of results.
Large calamondins in orchard.	Punctured with sterile water and needle.	10	Per cent. 20	February 26, 1920.	March 10, 1920.
Do.	Punctured with needle and infusion of yeast.	20	35	do.	Do.
Do.	Not punctured but immersed in yeast infusion.	10	0	do.	Do.
Ripe calamondins in orchard.	One needle puncture and pure culture of yeast.	10	60	do.	Do.
Ripe daidai ^b fruits in orchard.	do.	10	90	do.	Do.
Ripe daidai fruits in moist chamber.	One needle puncture with sterile water.	5	20	June 5, 1920.	August 8, 1920.
Do.	One needle puncture and infusion of yeast cells.	5	100	do.	Do.
Do.	Needle puncture with sterile water.	10	30	August 28, 1920.	September 20, 1920.
Do.	Needle puncture with yeast culture.	12	50	do.	Do.
Do.	Needle puncture with sterile water.	9	22	October 5, 1920.	November 29, 1920.
Do.	Needle puncture with yeast culture.	10	70	do.	Do.
Do.	Needle puncture with sterile water.	11	0	May 6, 1921.	June 1, 1921.
Do.	Needle puncture with yeast culture.	10	70	do.	Do.
Batangas mandarin oranges in moist chamber.	Needle puncture with sterile water.	5	0	March 11, 1921.	March 22, 1921.
Do.	Needle puncture with yeast culture.	5	20	do.	Do.

^a I was assisted in making these inoculations by Mr. Mariano G. Medalla, assistant pathologist of the Bureau of Agriculture, to whom credit and thanks are due.

^b Daidai is the Japanese name for a sour orange of the Seville type, *Citrus aurantium*.

^c Fungus recovered from each positive case, either under microscope or in culture.

It is rather reassuring also that whenever the disease is found in the controls the organism can usually be shown to be present by microscopic examination or by isolation in culture.

The constant isolation of this yeast in culture probably from 150 naturally occurring diseased fruits, obtained in a number of different conditions and from widely separated districts, of course is also a strong corroboration of the inoculation results. Normal fruits show no traces of this organism.

In such pioneer work with limited time it has been difficult to secure the opportunity for even these preliminary tests; however, the importance of forewarning citrus growers and research men of this disease urges the publication of these preliminary tests.

DESCRIPTION AND IDENTITY OF THE FUNGUS

In culture and on slides from affected fruit tissue, no considerable mycelium has ever been observed, although occasional small bits of irregular-appearing hyphæ may sometimes be found. The only forms of the organism observed from fruits and from cultures are ordinary yeast cells; much larger, rounded cells; club-shaped bodies, such as shown in fig. 1; and sporangia and spores, also shown in fig. 1. The forms frequently may



FIG. 1. The distinctive forms of the causal organism of dry rot. To the right, asci enclosing eight ascospores in two clusters of four spores each. To the left, the long, slender ascospores showing the thinning granulation toward the tips, the projection just below this thinning granulation, and the long appendages. To the left is one of the anomalous club-shaped bodies.

all be seen on one slide from affected orange tissue. The yeast cells are ellipsoidal, approaching spherical, but not distinctive. The large round cells and the club-shaped bodies are difficult of comprehension; the walls of these bodies are slightly thicker than the walls of the yeast cells or of the sporangia but, other than this and their peculiar shape, nothing can be said of these bodies. The sporangia and spores are very distinctive; what appear to be young, newly forming sporangia can be seen frequently, and apparently the sporangia are developed by the enlargement of a single cell, such as Nowell⁽²⁾ described for his

form D, and are thin-walled, hyaline, and elongate. Each sporangium observed contained two groups of four closely compacted spores; that is, eight spores to each sporangium.

The spores are extremely long and slender, narrowing gradually at one end into an extremely long appendage which has the appearance of a flagellum. The contents of the spores are rather densely granular and with a peculiar lessening of granulation in the upper half of the spore farthest from the appendage, as shown in fig. 1. Slightly above the middle of the spore, regarding the appendage as at the lower end, is a distinctive area of almost entire absence of granulation, which in some spores has the appearance of being a cell wall. It is not seen in the young, less-mature spores, and careful observation of many spores leads to the opinion that this is not a definite cell wall. A slight projection appears on each spore just below this area devoid of granulation, and this projection, the flagellumlike appendage, and the markedly lessened granulation in the upper end of the spore are the distinctive characters of the spores. All of these features are shown very definitely in fig. 1. These characters are seen readily in the spores without staining, but with carbol fuchsin or gentian violet are shown more clearly.

The spores are also shown in fig. 1, lying in the sporangium in characteristic position. The spores lie with their thinly granulated ends toward the extremities of the sporangia while the appendages from one group of four spores overlap the spores of the other group.

The sporangia are usually 75 to 110 by 6.5 to 20 micromillimeters in size, and the spores vary from 42 to 66 micromillimeters in length and are usually 1.5 to 3 millimeters at their greatest width. The appendages are from 11 to 40 micromillimeters in length. It is rather difficult to determine which point should be taken as the end of the spore and the beginning of the appendage.

The yeast cultures readily makes a quick growth on nutrient beef agar and a very copious growth on potato cylinders. On agar plates the growth resembles that of bacterial colonies more than that of a fungus; growth is rapid at laboratory temperatures of 28° to 30° C., round to irregular, rather grayish or dirty white, raised to pulvinate, surface irregular and hummocked, edge entire, and internal structure granular. The

colony is of an easily separated consistency, and there is no marked or characteristic odor.

Peglion⁽⁵⁾ described a fungus as *Nematospora coryli* growing upon the hazelnut (*Corylus avellana*), which is very similar to the yeast on oranges. The original description has not been available to me, but a second paper by Peglion⁽⁶⁾ describes the fungus completely and this paper has been available. The disease of hazelnuts is very similar in its pathological aspects to the disease of oranges reported here. In many cases, according to Peglion, the disease cannot be observed externally on the fruits of the hazel but is found only on breaking into the nut. The disease imparts a peculiar, disagreeable taste to the nut, but does not cause a putrid decay. Peglion found that the disease varied from year to year but never attacked less than 5 to 6 per cent of the nuts observed in the markets.

Concerning the fungus of the hazelnut disease, Peglion describes elongate, sharply pointed yeast cells, definite mycelium, thick-walled, irregular-shaped bodies which he called anomalous vegetative forms, and asci and ascospores. The asci are identical in character and shape with the sporangia of the citrus dry-rot fungus and contain the same number of long, needle-shaped spores with long appendages, arranged in the same order of two groups of four spores each. Peglion described his fungus as a new genus and species of the order Saccharomycetae, *Nematospora coryli*. The citrus dry-rot organism belongs quite naturally in this genus.

There are a few minor differences between the *Nematospora* of the citrus disease and *N. coryli* Peglion. Peglion's drawing shows the yeast cells of *Nematospora coryli* uniformly more elongate and sharply pointed than are the yeast cells of the orange dry-rot fungus. He also describes a very definite mycelium, which has not yet been observed in the citrus dry-rot fungus in the Philippines. Peglion did not describe thick-walled, club-shaped bodies such as are found in the cultures of the orange fungus, but described forms, very similar in structure but not in shape, as anomalous vegetative forms. The ascospores are very similar in both, being long, slender, and with long appendages, although the fungus from the hazelnut has spores which do not show the septumlike absence of granulation that is seen in the spores of the orange fungus. Peglion gives the dimensions of the spores of *N. coryli* as 38 to 40 by 2 to 3 μ .

and the flagella 35 to 40 μ in length, and the dimensions of the citrus fruit *Nematospora* are quite similar. In culture, however, there is also a marked difference, since the hazelnut fungus, according to Peglion, forms very distinct crateriform colonies on beef agar, while the fungus from citrus fruits forms very decided pulvinate colonies. It would seem that the *Nematospora* of the citrus disease is a species quite distinct from *N. coryli*.

It is of interest to note that Peglion inoculated his *Nematospora coryli* upon hazelnuts but, similarly to my first experiences in the Philippines, he had difficulty with other fungi causing decay. His belief, however, was to the effect that infection of the hazelnut took place while the fruit was young, and not toward maturity as is apparently the case in citrus fruits.

In 1916 Schneider(7) described a fungus, found upon a tomato from tropical regions, causing a pathological condition on the tomato very similar to the condition found on oranges in the Philippines. He described yeast cells very similar to those of the citrus dry-rot fungus, large round cells, and club-shaped bodies identical with those described here. The asci and ascospores of Schneider's fungus were, moreover, almost identical in shape and character with those of the Philippine citrus dry-rot fungus. The ascospores are slightly shorter and not so slender as the spores of the citrus fungus, although their appendages are longer. Schneider calls the large round cells of his fungus arthrospores, but I hesitate to apply this term to the round cells of the citrus dry-rot fungus. He also writes of gametic fusion processes which have not been observed as yet in the case of the citrus-fruit *Nematospora* in the Philippines. In a later paper Schneider(8) described the tomato fungus as *Nematospora lycopersici*. No cultures of the fungus were made, nor were inoculations attempted.

Nowell(3) has published an account of the internal boll disease of cotton in the West Indies which is characterized by a discoloration of the lint within the boll and a premature dropping, but the bolls show no external evidence of the disease whatsoever. The disease in its general character is very similar to the hazelnut disease of Peglion, the tomato disease of Schneider, and the citrus dry-rot disease in the Philippines here discussed. Nowell(2) has described four closely related fungus species associated with the internal boll disease of cotton, one of the fungi without question being a *Nematospora*. Insects which puncture the cotton bolls were suspected by various writers of causing

the lint discoloration, but Nowell showed the presence of the fungi and, by careful bagging experiments, showed that the infection was brought about by insect punctures.

Nowell described his cotton-boll disease fungi as forms A, B, C, and D; form D consists of elliptical to ovoid yeast cells, large spherical cells similar to the arthrospores of Schneider, sporangia and spores very similar to those of Peglion's *Nematospora*, and definite mycelium formation. The spores of Nowell's form D are very similar in size to those of *N. coryli* and but slightly smaller than those of the Philippine citrus fungus. The citrus dry-rot fungus of the Philippines answers very closely to the description of Nowell's *Nematospora*, with the exception that in the Philippines definite mycelium has not yet been observed in connection with the citrus dry-rot fungus. It is believed, however, that conditions and circumstances for the growth of the species could easily influence the presence or absence of the mycelium.

In a later short note, moreover, Nowell records the observation of his form D on oranges in Barbados causing a pathological condition similar to that found in the Philippines. He found insect punctures accompanying the disease on the orange also as well as on the cotton bolls. Therefore, identity of the citrus dry-rot *Nematospora* with Nowell's form D would seem to be quite definite. In as much as further work will possibly uncover considerably more knowledge of the morphology of the fungus, and since Nowell has already done much work on the problem, it would seem well to refrain from describing it as a new species in the present paper. For the present, reference to the fungus is easily possible by calling it the citrus dry-rot *Nematospora*.

Nowell does not regard the species of the genus *Nematospora* as ascomycetes, his view being based apparently upon the absence of gametic processes in these fungi. On the other hand Guillermond(1) states:

The ascospores in certain yeasts present on the other hand characteristic forms absolutely analogous to the ascospores of certain Ascomycetes. Thus it is that ascospores of * * * and *Nematospora coryli* have forms which suggest very strongly those of certain Ascomycetes.

It would seem as if there were some justification, therefore, for holding for the present at least to a rather interesting placing of these fungi with the Saccharomycetae in the systematic arrangement.

PATHOLOGICAL HISTOLOGY

Opportunity has not been available for the exhaustive study which would be desirable for this phase of the disease. In the absence of insect studies it is only possible to conclude, from the analogy of citrus dry rot with internal boll disease of cotton, that insects are passive carriers of the *Nematospora* of citrus dry rot. This would possibly explain the absence of infection in the pummelo and grapefruit, since such fruits have very thick skins through which it would be difficult for an insect puncture to penetrate. It is noticeable also that the thin-skinned mandarin oranges and calamondins are abundantly infected while the sweet-orange fruits of the Philippines with thicker skins are much more rarely affected.

It is of interest to note also a chance finding of *Nematospora* spores on the bark of citrus trees. An examination under the microscope was made of scale insects being parasitized by fungi, and a scraping was unintentionally made of the bark of the host tree; several isolated *Nematospora* spores were observed in such scrapings, indicating widespread distribution and ready chances for infection.

Even when the organism has secured entrance into the pulp of the fruit the pathology is not entirely clear. Study of the cells of the tissues of the vesicle walls shows immense numbers of yeast cells present, but in no case have any such yeast cells been definitely shown within the host cells; they apparently exist between the vesicles and cells of the vesicles. Apparently such conditions are very favorable for the development of the organism and multiplication is very abundant. In the tissues the large round cells and yeast cells are predominant, while the asci and ascospores are present but not as abundant as in cultures.

Frequently in an affected fruit small white specks may be observed; under the microscope these are found to be masses of the fungus, usually all forms being present but the asci especially numerous. Such white masses of the organism in the tissues are one of the peculiar features of the disease, not uniformly present but still by no means rare.

It is also difficult to account for the drying up and inspissation of the tissue. Apparently the vascular system is not interfered with; examinations have been made with this particular point in view and no evidences of the organism in either phloem

or xylem cells have been apparent. On the other hand, the cells of the vesicle walls are very much changed in pathological tissues. The walls are thickened, irregular in outline, and apparently disrupted in some cases. It would seem as if the growth of the yeast may result in by-products which bring about this effect on the cells and the resulting pathological condition.

SUGGESTIONS FOR CONTROL

At Lamao, Philippine Islands, spraying experiments against citrus canker were carried on in 1917 and 1918. In the beginning of these experiments fruits on trees in the sprayed plots were found to be badly affected by dry rot. Two trees of the sour orange (*Citrus aurantium*) are on record as having over 80 per cent of the fruits affected by dry rot. At the conclusion of the experiments the two trees, having been sprayed with Bordeaux 4-4-50 four times during the season, were found to have practically all fruits free from dry rot. The case is so confined as to be of little value, except as an indication that certain procedures of spraying might be successfully tried experimentally against dry rot. The effect of applications of fungicides to citrus trees would certainly lessen the number of disseminated *Nematospora* spores.

Control for the citrus-growing districts of the United States, of course, should consist in the entire exclusion of the fungus. For this reason rigid maintenance and enforcement of quarantine regulations should be practiced:

SUMMARY

A disease which attacks the fruits of citrus trees is described and the name dry rot is given to it. Dry rot destroys the desirable eating qualities of fruits and, once introduced into the United States, would cause considerable loss to the orange growers.

The disease has been found in the Philippine Islands, in China and Japan, and has been reported by Nowell from Barbados, in the West Indies. Its distribution precludes the possibility of temperature being a limiting factor in the development of the disease in the United States. The disease has been observed to affect the sweet orange, the mandarin orange, the sour orange, and the calamondin. No observations are available for the lemon, the lime, or the cabuyao. The pummelo is believed to have some degree of resistance to the disease. Preliminary

experiments show the cause to be a yeast of the genus *Nematospora* of Peglion. The fungus is described but a much more complete comparative study is desirable before naming it as a new species.

Although spraying may prevent the disease, it is suggested that control for American growers lies in the prevention of the introduction of the disease into the United States, by rigid enforcement of quarantine regulations.

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ILLUSTRATIONS

PLATE 1

FIG. 1. A normal fruit of *Citrus aurantium*.

FIGS. 2 and 3. Two fruits of the same species affected with dry rot, showing thickened section walls and inspissated vesicles.

PLATE 2. CALAMONDIN FRUITS, CITRUS MITIS, AFFECTED WITH DRY ROT

FIG. 1. Early stages of infection showing thickened section walls.

2. Fruits showing advancing stages of the disease.

TEXT FIGURE

FIG. 1. The distinctive forms of the causal organism of dry rot. To the right, asci inclosing eight ascospores in two clusters of four spores each. To the left, the long, slender ascospores showing the thinning granulation toward the tips, the projection just below this thinning granulation, and the long appendages. To the left is one of the anomalous club-shaped bodies.

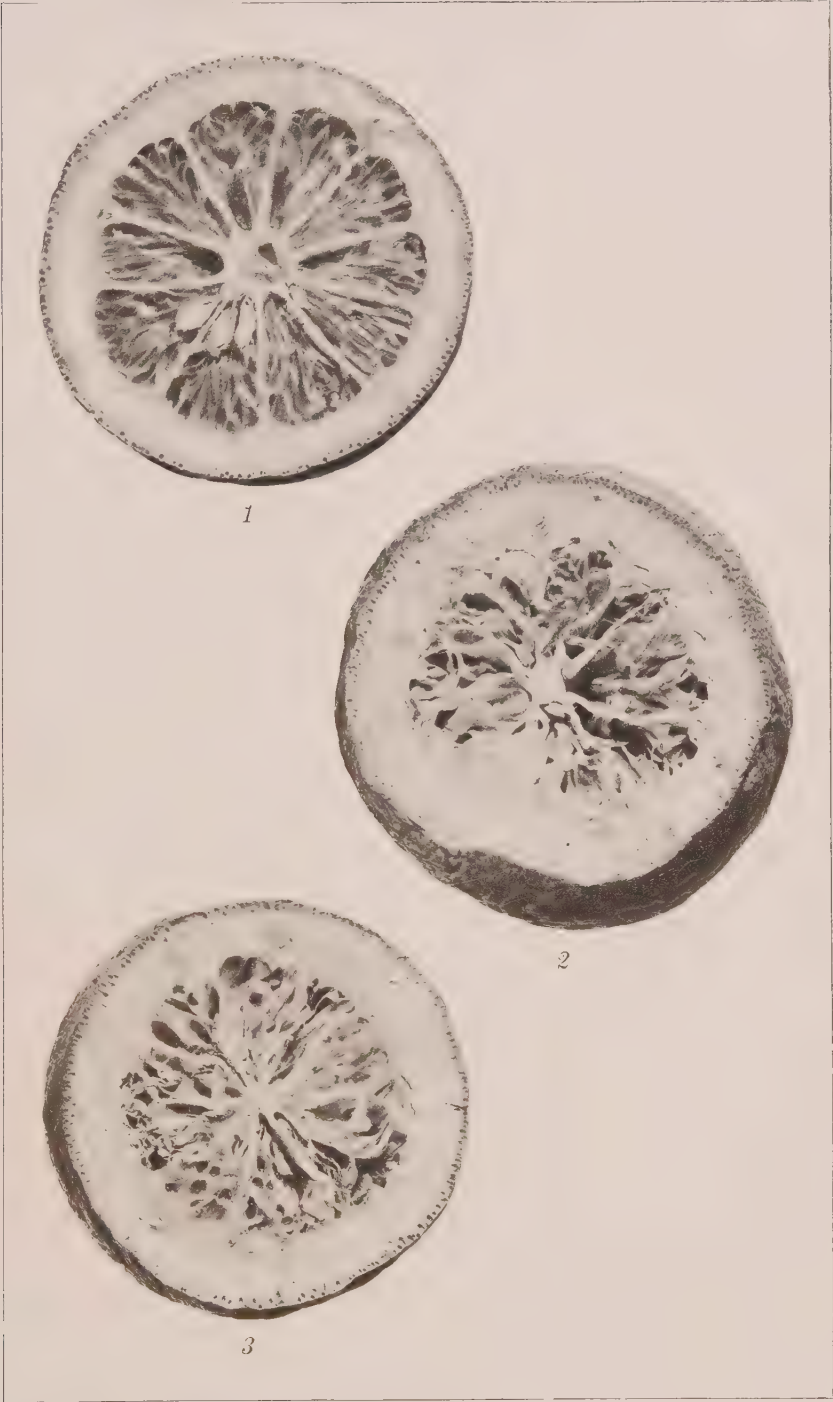


PLATE 1.

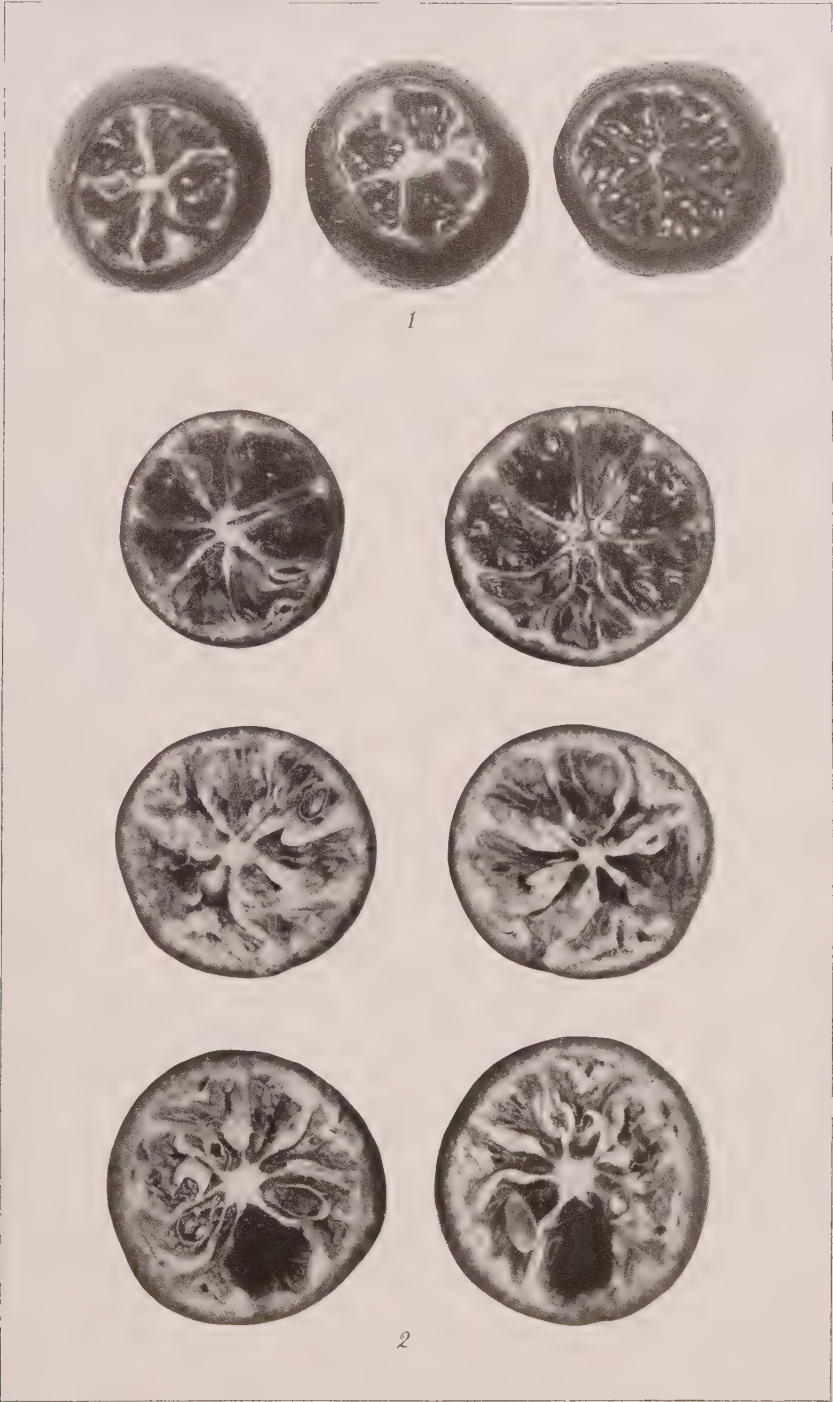


PLATE 2.

BACTERIOLOGICAL EXAMINATION OF STOOLS OF FOOD HANDLERS IN MANILA

By O. GARCIA and A. VAZQUEZ-COLET
Of the Bureau of Science, Manila

and

G. R. LACY
Of the International Health Board

One of the greatest sanitary problems in the Philippines is that of controlling diseases of the intestinal tract. During the past there have been severe epidemics of cholera, typhoid fever, and dysentery. Cholera has been placed well under control, so that at the present time it is not a serious menace, but only requires scrupulous care to see that it does not again break out in the Islands. Typhoid fever and bacillary dysentery, on the other hand, are endemic and very frequently reach epidemic form. The control of these depends largely upon the ability of the Public Health Service to trace down the source of infection and to control the surroundings of the actual cases and the known carriers. Many of the reported epidemics of typhoid fever and dysentery have been traceable to some one definite source of origin. Some of these have been well-defined clinical cases, some mild or ambulatory cases, and still others carriers, all of whom have served as foci for epidemics either by direct contact with other persons or by their excreta contaminating the food and water supply of others. Schule¹ reports that in the area served by the German laboratory at Trier it was possible to determine the source of 67 per cent of the infections occurring in that area during 1918. Sixty per cent of the infections were due to contact with other cases, 5 per cent to contact with carriers, and 1 per cent each to infected milk and water.

At all times the food handler is looked upon with suspicion when an epidemic of intestinal disease arises. As a result of the prevalence of typhoid fever in Manila during the past year, we were called upon to examine the fæces of food and water handlers on a very large scale. Two groups of the personnel

¹ Schule, Paul A., *Military Surgeon* 45 (1919) 268.

of the biological laboratory, Bureau of Science, were engaged almost exclusively in this work for a period of approximately six months.

In so far as we were able to determine, all of the food handlers, whose stools were examined by us, were healthy persons. We would like therefore to emphasize the fact that when the term "food handler" is used in this report it refers only to healthy persons and does not refer to typhoid and dysentery patients nor to convalescents from either. We will refer in Table 2 to the examination of stools of patients and contacts, merely as a control on our technic.

COLLECTION OF STOOLS

At first the stools were collected at the various public-health stations in the city and were sent from there to the Bureau of Science, where they were cultured. This procedure involved of course a delay of several hours in some cases from the time the stool was passed until it was cultured. The consistently negative findings in these cases caused us to feel that the long delay in culturing the stools might be an important factor in producing the negative results. Arrangements were then made whereby one portion of the persons whose stools were to be examined were to come to the Bureau of Science and pass a stool while there, so that it might be cultured under the most favorable conditions. In a few instances of course this worked a hardship on the applicant who was unable to pass a stool and who had to return at a later date. We feel that the procedure was justified in view of the fact that we were able entirely to rule out the time factor. We were somewhat surprised to find that practically all stools examined under these favorable conditions were also negative for typhoid, paratyphoid, dysentery, cholera, and non-agglutinating vibrio. One of the bacteriological sections examined a total of 1,617 stools, approximately half of them by the first method of collection and the other half by the second method. A sufficient number was examined, therefore, to judge between the methods, had there been any difference in the results. A brief history was obtained from each person examined, the chief points of which were the person's age, occupation, place of occupation, residence, public-health district, and whether the person had received prophylactic inoculation with cholera and typhoid vaccine.

TECHNIC OF CULTURING

The technic generally used in these examinations was as follows: When the specimen was received a portion of the feces was inoculated into nutrient broth, incubated for from three to five hours at 37° C., and then streaked on plates of Teague methylene blue eosin medium and litmus lactose agar, and some of the specimens were also streaked on Endo plates. They were allowed to incubate for from twelve to twenty-four hours, when they were examined for suspicious typhoid and dysentery colonies. When such colonies were found they were transferred to modified Russell's double sugar medium and microscopic agglutination tests were made. If the Russell's double sugar tubes were still suggestive of typhoid or dysentery, macroscopic agglutination tests were made and differential carbohydrate media were inoculated. For the detection of cholera and non-agglutinating vibrio, a small portion of the stool was emulsified in 5 to 7 cubic centimeters of the following medium: Ten grams peptone (Witte or Merk); 5 grams sodium chloride; 1,000 cubic centimeters tap water; adjusted to 0.5 per cent alkaline. The tube was incubated for from eighteen to twenty-four hours, examined for motility, and plated on Dieudonne medium. The plate was incubated for twenty-four hours and examined for suspicious colonies. These colonies were tested for motility, agglutinability, and staining qualities.

The results of the investigation by the first group are shown in Table 1.

TABLE 1.—*Stools examined by first group, April 24 to October 24, 1923.*

Public-Health District:	
No. 1	188
No. 2	47
No. 3	0
No. 4	281
No. 5	290
No. 6	811
Results:	
Positive ^a	2
Negative	1,615
Typhoid inoculations:	
Complete series	556
Two	135
One	772
None	154

^a One of these two carriers was found positive twice, while the other has continued positive each week for a period of approximately five months.

One of the most interesting features brought out in this part of the investigation is the high percentage (approximately 90.5) of positive inoculations with cholera and typhoid vaccine. The complete series of injections had been given to 34.3 per cent; two injections, to 8.5 per cent; and one injection, to 47.7 per cent, leaving 9.5 per cent who had received none. It must be remembered that these figures were taken at a period when a special antityphoid campaign was being conducted. This speaks very highly for the efforts of the Public Health Service to control the typhoid situation.

The second group of workers did not confine themselves entirely to the examination of stools from food handlers, but received specimens also from a group of healthy persons taken at random, and from patients chiefly from San Lazaro Hospital and from persons who had been in direct contact with typhoid or dysentery cases. The number examined by this group was greater than that examined by the first group, but the data were less complete. The results will, therefore, be given in a separate table. Some of the stools examined by this group were from the same persons as were some of those examined by the preceding group, but they were collected at different times. The technic was the same in both groups.

Table 2 shows the results of the work performed by the second group.

TABLE 2.—*Stools examined by second group.*

Food handlers	3,184
Healthy persons selected at random	269
Patients of San Lazaro Hospital	816
Persons directly in contact with typhoid or dysentery cases	1,072
Convalescents	201
Total	5,542
Results: *	
Positive—	
Typhosus	19
Paratyphosus A	1
Dysenteriae	22
Negative	5,500

* Food handlers and other healthy persons all negative. All positives were isolated from patients.

By referring to Table 2, it will be seen that the total number of those classed as food handlers, contacts, and healthy persons is 4,525, and that all of them were negative for typhoid, paratyphoid, dysentery, cholera, and non-agglutinating vibrio. Only a small portion of the 1,017 patients and convalescents were clinically positive for typhoid or dysentery, and from these typhoid bacillus was isolated nineteen times, paratyphoid A bacillus once, and dysentery (Shiga and Flexner) twenty-two times.

At the present time we are studying the urines of typhoid patients and convalescents to determine whether a larger percentage of positive cultures can be obtained from the urine than from the blood and fæces of the same patients.

Combining the results of the two groups, we have a total of 6,143 examinations of stools from apparently healthy people with only two positive for typhoid bacilli. Using the same technic for the examination of stools from patients, we obtained a reasonable number of cultures positive for typhoid and dysentery.

It is possible, of course, that the method of obtaining the stools might have been improved upon in two ways. First, the samples might have been more satisfactory had the applicants been given purgatives the night before the examinations were made. This would have insured a fluid stool and also one from higher in the intestinal canal. Since the majority of typhoid carriers are supposed to harbor the typhoid bacillus in the gall bladder, it appears theoretically that a method which would give a specimen of fæces from the upper portion of the intestines would be the method of choice.

The second, and perhaps the most important, improvement that could have been made in the collection of the stools would have been multiple examinations of the patients' stools; for example, an examination of the stools at least three times, with intervals of from three days to a week between examinations. It might be of interest to note at this point that, in a personal interview with the chief of the laboratory division of the United States Army, we were told that they had recently completed several thousand examinations of the stools of food handlers in the United States Army and that they found only one typhoid carrier in the number examined. This report is entirely in accord with our own findings in Manila.

As a matter of interest to those carrying on the work, the last 730 stools were examined microscopically for parasites and ova. The results of this feature of the work are shown in Table 3.

TABLE 3.—*Microscopic examination of stools for parasites and ova.*

<i>Ascaris</i>	428
<i>Trichuris</i>	338
Hookworm	109
<i>Strongyloides</i>	4
<i>Oxyuris</i>	3
<i>Tænia</i>	4
<i>Lambliæ intestinalis</i>	2
<i>Blastocystis</i>	10
<i>Entamœba</i>	70
Single and multiple infections:	
Single	322
Double	246
Triple	54
Quadruple	6
Total:	
Positive	628
Negative	102

In these examinations three slides were prepared from each specimen; if they were all negative, the concentration method was used. It can be seen at a glance that the intestinal parasites are highly prevalent among this apparently healthy group of food and water handlers. Approximately 60 per cent show *Ascaris*, 46 per cent *Trichuris*, and 15 per cent hookworm. No doubt the hookworm incidence in Manila is much higher than is indicated by this limited number of examinations. Since we were interested primarily in the bacteriological phase of the problem, we shall let this portion of the report stand without further comment.

In conclusion, we would like to call attention to the fact that, in our examination of over 6,000 stools from food handlers and other healthy persons, the typhoid bacillus was isolated from but two persons, and that all were negative for dysentery, cholera, and non-agglutinating vibrio. This indicates to us that the wholesale examinations of single stools from food handlers in a city like Manila is not warranted. We do not wish to underestimate the fact which is generally known that the stool of a typhoid carrier may be negative on one examination and positive on the next. As a result of our findings and those referred to, in the United States Army, we would venture the opinion

that at the present time the chronic carrier is not as serious a factor in the epidemiology of typhoid and dysentery as he has previously been considered to be. It is possible, however, that the large percentage of prophylactic inoculations with cholera and typhoid vaccine may and probably does reduce the number of carriers. The convalescent patient or temporary carrier, or the person who is suffering from a mild infection, or one who is in direct contact with an active typhoid or dysentery case, either of whom happens to be a food handler, creates a problem different from that of the average food handler and must be dealt with as the occasion arises. These individuals can only be detected by the combined efforts of the sanitarian and the bacteriologist.

NEW DYTISCIDÆ

By A. ZIMMERMANN

Of Munich, Germany

Gaurodytes philippensis sp. nov.

Length, 6.25 millimeters; width, 3.25. Subelongate oval, beneath black, epipleura and apices of ventral segments pale; palpi, antennæ, and the four anterior legs rufous, femora and tibiæ of hind legs piceous. Head and thorax blackish, not or faintly æneous, the former with clypeus and two obscure spots on vertex, the latter with the sides and sometimes also with the basal margin narrowly rufous. Elytra rufous, almost unicolorous, only on disk of posterior half very slightly infusate.

The elytral reticulation is very minute and uniform throughout, without fine punctulation. The usual dorsal series of punctures fine, but behind considerably confused. Reticulation of thorax and head stronger, the meshes larger and unequal. Prosternal process rather small and convex before, feebly convex or flattened and slightly margined behind coxæ; the lateral wings of metasternum rather small. Protarsi and mesotarsi of male rather feebly dilated, protarsal claws simple, not longer than in female.

Probably a high-mountain species belonging to the *congener* group; it is very close to both *japonicus* Sharp and *æquabilis* Gschwendt but is quite distinct on account of its pale rufous elytra and smaller size. The reticulation of thorax and head is appreciably stronger and the meshes are rather larger.

LUZON, Benguet Subprovince, Mount Pulog (*McGregor*).

Described from four examples, 1 male and 1 female in my own collection, and 2 males in the collection of the Bureau of Science, Manila.

Gaurodytes bakeri sp. nov.

Length, 6.5 to 6.75 millimeters; width, 3.25 to 3.5. Extremely close to *philippensis*, but separable with certainty by the more oblong and subparallel form of body, which is scarcely enlarged in the middle. Head and thorax with rather distinct æneous luster, the pale side margins of the latter smaller, the

elytra considerably more infusate, the legs darker, the femora of the four anterior legs piceous, prosternal process behind coxæ a little broader.

LUZON, Benguet Subprovince, Baguio (*Baker*).

I have seen a considerable series, the greater number from the collection of Prof. C. F. Baker, Los Baños.

Hydaticus schultzei sp. nov.

Length, 11 to 11.5 millimeters; width, 6.25. Oblong-oval, rather feebly convex. Body shining, beneath piceous, the abdomen rufopiceous, the first four segments with a rufous spot on each side. Epipleura, prosternum, antennæ, palpi, and the four anterior legs rufous, swimming legs black. Head and thorax rufotestaceous, the former with a small black basal fascia and a rather broader band along the posterior half of the eyes, the latter with a broad median spot, which is enlarged before and behind. Elytra black, each with a very small side margin, a small subbasal fascia (reaching neither the suture nor the shoulder) and four well-isolated clear spots rufous; one of these forms an irregular semicircle on the shoulder, one is subapical, and of the two others a little behind the middle the inner is roundish, the outer rather oblique.

Reticulation very minute; over the upper surface minute punctules irregularly and sparingly distributed, a little stronger and denser on the head. On each side of thorax is a group of more distinct punctures and in the female there is also a large field of irregular very strong scratches.

In general aspect the new species resembles *macularis* Reg. from Palawan, but is quite surely distinct by the rufous color of head, thorax, and epipleura and by the much stronger sexual sculpture of the female.

PALAWAN, Taytay; Iwahig, Rio Quinina (*Schultze*).

A male and a female in my collection; a second male in the collection of the Bureau of Science, Manila.

THE PHILIPPINE SPECIES OF PAREVASPIS, A GENUS OF BEES

By H. L. VIERECK

Of Ottawa, Ontario, Canada

ONE TEXT FIGURE

If I have correctly correlated the sexes, then I have to report from the Philippine Islands at least two new species of this genus or subgenus. According to Reinhold Meyer's key¹ these species agree with *Parevaspis polynesia* Vachal and *P. strandi* Meyer in having the abdomen entirely red or reddish, but differ in the female in having the sixth sternite simple except for a central swelling.

Parevaspis bakeri sp. nov. Fig. 1, *a*, *b*.

Type.—Male, catalogue No. 26601, United States National Museum.

Allotype.—Female, catalogue No. 26601, United States National Museum.

Type locality.—Kolambugan, Mindanao (*Baker 17235*).

Male.—Length, 12 millimeters; front and vertex with coarse, deep, adjoining or nearly adjoining punctures but not everywhere as close together as possible, punctures of mesonotum not so coarse as on the front, the puncturation here more uniformly dense than on the front and vertex, scutel with larger, shallower punctures than the dorsulum, its punctures not so close together, scutel slightly indented at apex in the middle, the interstices of the puncturations elevated, scutel uniformly black like the rest of the thorax and the head, sixth and seventh sternites in outline as figured, fifth sternite with a median triangular tooth on its apical edge, hypopygium as figured.

Female.—Length, 16 millimeters; agrees with the male except for the secondary sexual characters. This female is from Surigao, Mindanao (*Baker 17232*).

Parevaspis impressus sp. nov. Fig. 1, *c*, *d*.

Type.—Male, catalogue No. 26602, United States National Museum.

¹ Archiv für Naturgeschichte (1921).

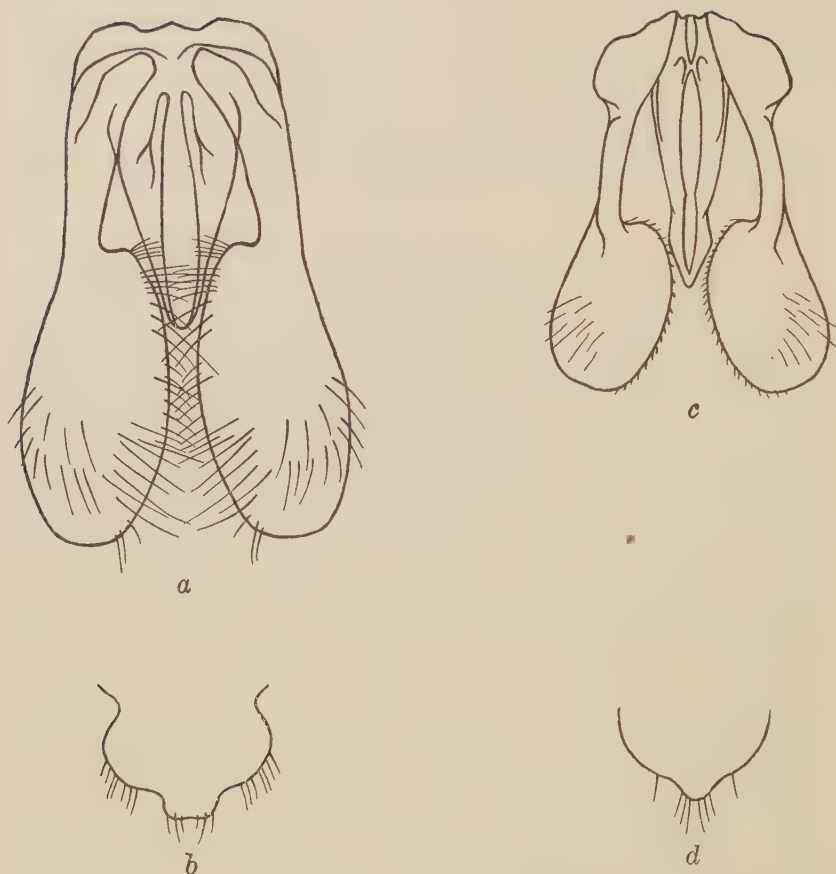


FIG. 1. *Parevaspis bakeri* sp. nov., male, a, hypopygium; b, seventh sternite. *Parevaspis impressus* sp. nov., male, c, hypopygium; d, seventh sternite.

Allotype.—Female, the same catalogue number.

Type locality.—Surigao, Mindanao (*Baker*).

Male.—Length, 11 millimeters; agrees with the above description of *Parevaspis bakeri* except as follows: Punctures not so coarse, scutel at apex in the middle deeply impressed, almost emarginate, sixth and seventh sternites in outline as figured, fifth sternite simple, without a median or other tooth, hypopygium as figured. Two specimens, the paratopotype No. 17234.

Female.—Length, 10 to 12 millimeters; agrees with the male except in the secondary sexual characters. Three specimens. Los Baños, Luzon, No. 17230; Surigao, Mindanao, No. 17231; and one specimen without a number.

ILLUSTRATION

TEXT FIGURE

FIG. 1. *Parevaspis bakeri* sp. nov., male, *a*, hypopygium; *b*, seventh sternite. *Parevaspis impressus* sp. nov., male, *c*, hypopygium; *d*, seventh sternite.

TWO LARVAL PARASITES FROM THE PHILIPPINE PALM CIVET (*PARADOXURUS PHILIPPINENSIS*)

By MARCOS A. TUBANGUI

Of the University of the Philippines, Los Baños

TWO TEXT FIGURES

A male Philippine palm civet (*Paradoxurus philippinensis* Jourdan, 1837) was caught near the poultry yards of the College of Agriculture, University of the Philippines, Los Baños, on October 5, 1923, and was presented to me for autopsy through the courtesy of Dr. L. B. Uichanco. Mr. Zacarias de Jesus, who conducted the examination, found in the abdominal cavity two larval parasites, one of which has been previously reported in man in the Philippine Islands, while the other appears to be a new cestode larva.

Armillifer moniliformis var. *heymonsi* Sambon, 1922.

An oval cyst (fig. 1, *a*), measuring about 3 millimeters long by 2 millimeters wide by 1 millimeter thick, was found in the omentum under the greater curvature of the stomach. Through the thin layer of fibrous connective tissue composing the wall of the cyst, there was visible a coiled, segmented worm which, when mechanically stimulated, showed feeble but distinct movements. When removed from the cyst and examined under a binocular microscope, the segmentation of the worm was more apparent, the segments being marked by thirty rings or annulations which occur in series on the surface of the body. The worm measures 8 millimeters in length by 1 millimeter in maximum width. Its elongate body is divisible into two regions: a short, depressed anterior region, which is free from annulations and bears on the ventral surface four small hooks; and a long, cylindrical posterior region which is annulated and tapers posteriorly to a pointed cone. Except for its size, in other characters it bears a very close resemblance to one of the adult tongue worms which Sambon⁽⁴⁾ has recently placed in the new genus *Armillifer*, namely, *A. moniliformis*. The worm is, therefore, identified as the larval or, more correctly, the nymphal form

of this linguatulid, and is the second one to be recorded in the Philippine Islands. The first was reported in 1907 by Herzog and Hare⁽²⁾ who found what is very likely the nymph of the same species encysted in the liver of a Filipino. These authors described the parasite under the name *Porocephalus constrictus* which, according to Sambon, is a synonym for the nymphal form of a closely related species, *A. armillatus*. The general impression is, however, that Herzog and Hare probably had to do with the nymph of *A. moniliformis*, because so far as is known *Armillifer armillatus* is restricted to Africa, while the former is Oriental in distribution.

It is important to emphasize the occurrence of this tongue worm in the Philippines because of its transmissibility to man. It is also important, for practical reasons, to know the mode of its transmission which, fortunately, has been successfully determined by those who studied its life history. The source of infestation is the python, in the lungs of which the sexually mature parasites live and lay their eggs. If introduced into a suitable intermediate host, which is usually an animal preyed upon by pythons, the eggs develop into nymphal forms which are able to migrate through the tissues of the body until they become encysted. Based on two specimens which I have dissected, the Philippine reticulated python is frequently parasitized with *Armillifer moniliformis* or with a variety of this species. Taking into consideration that this snake is often seen near houses in some parts of the country, the danger of its transmitting the eggs of the parasite to human beings is unquestionably great.

SPECIFIC DIAGNOSIS

The following description is based on thirteen adult female specimens obtained from two reticulated pythons which were shot near Mount Maquiling at Los Baños. No adult male specimens are at hand to make the description complete, but I believe, from a comparison of my data with those given by Sambon⁽⁴⁾ and Heymons⁽³⁾ on adult females, that my Philippine specimens belong to a variety of *Armillifer moniliformis* which Sambon designates as *A. moniliformis* var. *heymonsi*.

Color, yellowish in the fresh state and ivory white in preserved specimens. Shape elongate, more or less cylindrical, tapering posteriorly and terminating in a pointed cone. Size, from 30 to 70 millimeters in length by 3 to 5 millimeters in

maximum width. Body is annulated, being encircled by thick, prominent bands or rings which are placed at intervals and somewhat obliquely, giving it the appearance of a screw nail. The rings or circlets are about 1 millimeter wide and number from 27 to 31. The most anterior rings are so closely placed that it is often difficult to count them. Posteriorly they are very distinct, being separated by transparent spaces which are from 1 to 2 millimeters wide. The last and, sometimes, the second to the last rings are incomplete on the ventral surface.

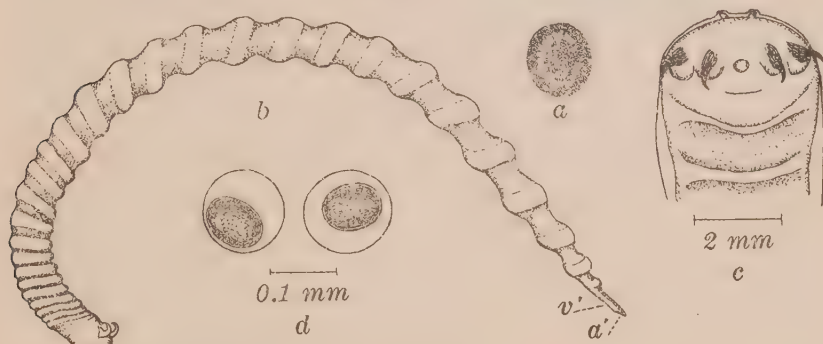


FIG. 1. *Armillifer moniliformis* var. *heymonsi* Sambon; a, encysted nymph, $\times 3.3$; b, side view of adult female, $\times 2$; c, cephalothorax, ventral view, showing the mouth and hooks; d, eggs.

The cephalothorax, which measures from 2 to 3 millimeters long by 3.5 to 4 millimeters wide, is not sharply marked off from the abdomen. It is flattened dorsoventrally, the ventral flattening being continued posteriorly as far as the tenth or fourteenth abdominal ring. The circular mouth is located on the ventral surface of the cephalothorax in line with four symmetrically placed hook pits, each of which contains a small, amber yellow hook. The hooks, two on each side of the mouth, are all of the same size and shape, each consisting of a curved, chitinous process about 1 millimeter in length. Two papillæ are present on the anterior border of the cephalothorax, one above and slightly median to each inner hook. An external pair of papillæ in line with the inner pair and above each outer hook is also sometimes seen.

The ringed abdomen contains the straight intestine and the coiled reproductive organs. The anus is located on the ventral surface of the last abdominal segment, about 0.082 millimeter from the tip of the terminal cone. The female genital opening

is anterior to and about 1.5 millimeters from the anus. The eggs are oval, double-shelled, and measure from 0.075 to 0.090 millimeter long by 0.056 to 0.064 millimeter wide. They are inclosed in transparent bladders which are from 0.107 to 0.125 millimeter in diameter.

Sparganum philippinensis sp. nov.

A single specimen of what is apparently a new cestode larva was found covered by the peritoneum beneath the psoas muscles. In the fresh state it looks very similar to a shred of fatty tissue or a piece of isolated nerve; it measures about 28 millimeters in length by 1 millimeter in maximum width. When removed from the body of the host and placed in physiological salt solution at room temperature, it exhibited slow, wormlike movements which were continued for nearly half an hour.



FIG. 2. *Sparganum philippinensis* sp. nov.; a, natural size; b, head end enlarged, showing invagination and slitlike opening.

The body is flat, nonsegmented, and covered with a cuticle which is very much wrinkled transversely. It is divided by a slight constriction near the junction of its anterior and middle thirds into a wider, shorter, anterior head portion and a narrower, longer, posterior portion. A short distance in front of the constriction there is a longitudinal, slitlike opening, about 1 millimeter in length. Whether or not this opening is an artefact, brought about by mechanical injury during the extraction of the worm from the tissues of the host, cannot be determined. It might possibly be a deep groove which has been ruptured. The anterior border of the head presents a protrusible invagination which is guarded on both sides by papilliform projections. The posterior extremity is rounded and somewhat thinner than the more anterior portions of the body. Neither suckers nor hooks nor other definite structures which would have suggested at once the taxonomic position of this larval parasite were evident during life. Only after it was stained with carmine and mounted, and finding under the microscope that the bulk of the body substance is made up largely

of a peculiar parenchymatous tissue in which minute calcareous corpuscles are scattered, was it possible to determine its cestode structure.

Similar forms of larval cestodes have been reported from various hosts, including man, and have been placed provisionally in the pseudogenus *Sparganum* Diesing, 1850, until their true position in the animal kingdom may be better known. It is a common belief, however, that they are the early stages of certain dibothriocephalid or dibothridiate tapeworms, this belief having been apparently confirmed in the case of *Sparganum mansonii* of man which is said to be the plerocercoid of *Dibothriocephalus mansonii* of the dog [Brumpt(1)]. If this view is correct and can be applied in a general sense, the present form, for which I propose the name *Sparganum philippinensis*, must be the larval stage of a cestode belonging to the dibothriocephalid or dibothridiate group. Based on this suspicion and on the observation that it is found in a host harboring another larval parasite, the adult stage of which is spent in the body of a python, I believe it probable that it is the plerocercoid of *Bothridium pithonis*, a very common tapeworm in the intestine of the Philippine *Python reticulatus*.

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ILLUSTRATIONS

TEXT FIGURES

- FIG. 1. *Armillifer moniliformis* var. *heymonsi* Sambon; *a*, encysted nymph, $\times 3.3$; *b*, side view of adult female, $\times 2$; *c*, cephalothorax, ventral view, showing the mouth and hooks; *d*, eggs.
2. *Sparganum philippinensis* sp. nov.; *a*, natural size; *b*, head end enlarged, showing invagination and slitlike opening.

Whereas it has pleased Almighty God in His wise and inscrutable Providence to remove from among us

Dean Conant Worcester

[OCTOBER 1, 1866-MAY 2, 1924]

Whereas at best we can do little at this time to indicate our real appreciation of him as a man and as a worker for the best medical and other scientific interests of the Philippine Islands; and

Whereas it was largely through his efforts, as Secretary of the Interior of the Government of the Philippine Islands, that the Philippine General Hospital, the Bureau of Science, and the College of Medicine were established; Therefore be it

Resolved, That we, members of the Philippine General Hospital, Bureau of Science, and College of Medicine, of Manila, Philippine Islands, do hereby express our deepest sorrow for the death of Dean Conant Worcester; and be it further

Resolved, That he holds a place of highest respect, admiration, and appreciation in the hearts of all of us because of the great good that he did as Secretary of the Interior in organizing the Philippine General Hospital, the Bureau of Science, and the College of Medicine; and be it further

Resolved, That we extend our sincerest sympathy and condolence to his widow, son, daughter, and other relatives; and be it further

Resolved, That these resolutions be engrossed and sent to his widow, and that copies be filed in the archives of the Philippine General Hospital, the Bureau of Science, and the College of Medicine, and published in the newspapers of Manila, in the Philippine Journal of Science, in the Journal of the Philippine Islands Medical Association, and in Science, the official organ of the American Association for the Advancement of Science, of which he was a member.

For the Staff of the Philippine General Hospital:

[L. S.]

FERNANDO CALDERON
JOSE ALBERT
J. I. ABUEL
F. E. JAYME

For the Staff of the Bureau of Science:

[L. S.]

WM. H. BROWN
LEON MA. GUERRERO
R. C. MCGREGOR
G. M. DE UBAGO

For the Staff of the College of Medicine:

[L. S.]

FERNANDO CALDERON
LIBORIO GOMEZ
ARTURO GARCIA
D. DE LA PAZ
JOSE ALBERT

At Manila, Philippine Islands, this fifth day of May in the year of our Lord one thousand nine hundred and twenty-four.

ERRATA

VOLUME 23

- Page 79, line 12, *for* specimens of these *read* specimens of this.
- Page 516, line 3 from bottom, *for* 1,000 milliliters; *read* 100 milliliters;
- Page 517, line 17, *for* Table 2.—*Maximum tolerated dose of cresote. read* Table 2.—*Maximum tolerated dose.*
- Page 518, line 4, *for* 10 cubic centimeters. *read* 12.5 milliliters.
- Page 518, line 8 from bottom, *for* Fig. 1. The maximum tolerated dose of creosote in leprosy patients, *read* Fig. 1. The maximum tolerated dose.
- Page 521, line 26, *for* Local Reactions *read* Lepra Reactions.
- Page 523, Table 7, column 5, *for* Moderately brief. *read* Moderately long.
- Page 524, line 14 from bottom, *for* 81 per cent, *read* 71 per cent.
- Page 525, line 4 from bottom, *for* Fig. 2. Progress made by leprosy patients under treatment with creosote, *read* Fig. 2. Progress made by leprosy patients under treatment.
- Page 526, line 5, *for* 'almost *read* approximately.
- Page 670, line 44, *for* *coerulans* *read* *caerulans*.
- Page 671, line 10, *for* *halconensis* *read* *confusus*.
- Page 671, line 28, *for* *gloriosus* var. *abbreviatus* *read* *gloriosus* subsp. *abbreviatus*.
- Page 672, line 8, *for* *coerulans* *read* *caerulans*.
- Page 672, last two lines, *for* Luzon, Benguet, Baguio *read* Luzon, Cagayan, Sanchez Mira.

VOLUME 24

- Page 265, line 10, *for* 4.5 *read* $\frac{4.5}{2}$.
- Page 338, line 38, *for* *Pachyrrhynchus bakeri* var. *read* *Pachyrrhynchus pulchellus* var.
- Page 468, line 28, *for* *Zanclodea* *read* *Zanclodea*.
- Page 468, line 36, *for* C2311 *read* 2311.
- Page 468, line 38, *for* C2311 *read* 2311.
- Page 478, line 11, *for* axial tufts *read* axial tufts.

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